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THE

JOURNAL OF SCIENCE.

OCTOBER, 1882.

I. EXPERIMENTATION IN BIOLOGY.

By OSWALD DAWSON.

(Concluded from page 542.)

IN the Pangenesis chapter Mr. Darwin acknowledges indebtedness to experimentation by quoting the renowned experiments of Brown-Séquard, and again, or rather previously, in the chapter on Inheritance; also the section of a Nais by Lyonnet; the amputations of the limbs of salamanders by Spallanzani and Bonnet, Lessona and Philipeaux; the transplantation of the spur of a cock, and piece of periosteum,—of the tail of a pig into its back; and, finally, the experiments on transfusion by Mr. Francis Galton. In everyone of these directions have similar experiments been performed. M. Dupuy observed the effects of a section of the sympathetic transmitted to the second generation; bicephalous planarians can be produced by an anterior longitudinal section,—it is a remarkable fact that the anterior portion of a bisected earth-worm reproduces a tail before the posterior a head (Dr. Ch. Leteauneau, Biology, "Library of Contemporary Science"); the "individuality" of this creature has been studied too much; Paul Bert succeeded in engrafting the frozen tail of a rat in its back; experiments on the growth and inheritance of mutilated spleens; experiments on transfusion and cross-circulation are numerous, but experiments *ad infinitum* in these directions are not needed. The high value of the researches of M. Camille Dareste on the production of monstrosities is appreciated in the most genuine manner—*i.e.*, by utilising

them—in the "Variation under Domestication," while they are pronounced "full of promise for the future" in the "Descent of Man."

The researches conducted so diligently of late, with a view to obtaining a precise knowledge of animal motion, may be mentioned as an example of biological experimentation. Those on the relation of muscle and nerve have become so popular as to be no longer confined to memoirs and text-books, but receive untechnical expositions in volumes designed for general readers, the same remark applying to the registrations of bodily movements. Researches of the latter class have been pursued independently and with great diligence by M. Marey in France, and by Dr. Pettigrew in this country (see this "Journal," April and October, 1875), while the well-known philosopher, physician, and cleric, the Rev. Prof. Samuel Houghton, has made elaborate series of measurements, and studied muscular action, in himself and his friends; but M. Marey fixes contrivances on to the bodies of animals, as upon birds in flight, entailing some inconvenience, and no doubt also alarm, on the part of the creatures. The prosecution of these studies in this country would result in the prosecution of the experimenter too. The same enthusiastic investigator conducted a series of experiments at Naples with a view to the determination of the analogies, of the pausings, rapidity, &c., between electric and muscular shocks, thus following up the researches of Matteucci and others, who have demonstrated that, in a dying *Torpedo*, touching the electric lobe will give rise to a discharge intenser than that produced normally and voluntarily. At the instance of Du Bois Reymond a journey to Venezuela was undertaken for the purpose of investigating the *Gymnotus*. Those who have read the "Night Side of Nature" will not underrate the value of electrical experiments on *dead* animals, for Dr. Rosenthal ascertained that from one and a half to three hours after death reaction of muscles to electrical stimulation disappears, and testing an apparent death by this method he prevented burial ("Journal of Anatomy and Physiology," November, 1872).

Experiments have been made in animal mesmerism. We are thus drifted into the question of experimentation in Psychology. To cite an extremely important example from an account of this "Journal" of May, 1880:—A dog ran round a cage containing hares for two hours, at the end of which period his olfactory nerves and interior membranes of the nose were dissected out and ground up in glycerin: this preparation, swallowed by or injected into a mastiff, caused

the dog to fear a cat, and the latter animal, after similar treatment, to be frightened to chase mice. The late Dr. Lauder Lindsay, in his "Mind in the Lower Animals in Health and Disease," and Dr. George J. Romanes, in his descriptive hand-book to a forthcoming treatise on Mental Evolution, quote Dr. Biddie's observation of a scorpion poisoning itself by means of its own sting.

Each of the last-mentioned cases independently suggests another, which leads us back to Physiology by as steady transition as when we left it. This account, too, is from this "Journal" (Dec., 1881), and is capable of condensation into four brief statements. The bite of enraged human beings may, like cobras, have fatal effects: in cobra-poison Dr. Gautier found an alkaloid possessing the properties of the ptomaines, which instantly convert potassium ferricyanide into potassium ferrocyanide, and which, when introduced into the system, occasion alarming symptoms, dilatation of the pupils, and death! the re-dissolved residue of evaporated saliva reduces the potassium ferricyanide, and, when injected under the skin of a bird, causes dilatation of the pupils, stupor, and death. Dr. Gautier finds the ptomaines are formed solely from the albumenoid portions of the dead body, though they occur in the normal excretions of man and of other animals, and in small quantities in our tissues.

And now, ye Sociologists, picture to yourselves the universal abolition of experimentation on the eve of the commencement of an exhaustive investigation of the genital system of the higher Mammalia. An impression prevails there is not that unanimity desirable respecting chastity. The exaggerations and habit-regulations of mendacious quacks and ill-informed clerics, of how little avail! appeals to Scripture when the very words which bind are rumoured capable of a biblical interpretation rendering them no guide; appeals to æstheticism, when it even seems questionable whether the dilution of sensuality vitiates or vivifies; appeals to a society that declines to recognise the policy of honesty essential to the attainment of its own equilibrium, compel each alike to insist upon a thorough investigation at the hands of Physiology.

And now we come to the Loving Cup—Experimental Neurology; hither repair the psychologist and the physiologist, the morphologist and the embryologist, the phrenologist and the metaphysician, the practitioner and the zoophilist. It is the subject of instruction to intelligent audiences for an evening's hour; its annals narrate scenes adapted to

amuse an errand-boy; it is the bond retaining the veteran physiologist who has abandoned general work; it is the surest subject to rivet the attention of beginners; it is employed as the prop of Materialism, and wielded as the two-edged sword of dualistic theories; volition is reported to prostrate itself before its iron arm—the arm that is so warmly embraced by a certain transatlantic dissenting minister. The fact that polemical literature is saturated with accounts of and allusions to neurological experimentation may be no criterion of its value in moulding thought, and thus directing action, and if anyone assert such he may not fear contradiction, for it can only be assumed that the courage requisite can have been generated by profound study of the matter. On the other hand, to trace clearly the direct effect of each individual discovery, and theory, and contradiction on the conduct of men, must be the task of a specialist, but that the results are appreciated is patent to all, save those who are too busily engaged in composing epithets and insults as to find everything not immediately appertaining to some declared advance in medical knowledge "a little beyond them." Few conceivable events would be likely to have a more profound influence on European thought (as far, of course, as it is possible to anticipate from the survey of bygones) than the re-announcement and subsequent publication of Prof. Huxley's "Bodily Motion and Consciousness." If this volume offered no acknowledgment to neurological experimentation it would be somewhat strange.

How far menageries fall in our province here it is not easy to determine. The ideal of Bacon is in accordance with the spirit of this article (as so far written): he writes—"We make them greater and smaller than their kind is; . . . we make them differ in colour, shape, activity, many ways; . . . we have particular pools where we make trials upon fishes, as . . . . (also upon) beasts and birds" ("New Atlantis"). The results of the production and crossing of hybrids are invaluable (see Karl Semper, Chap. XI.). Occasional observation of feats of intelligence are instructive, but there is liable to be difficulty in judging how far imitation misleads ordinary observers who attribute an action to other forms of reasoning; thus when the Polar bear set in motion the water of its pool to secure a bun, it may have previously seen an umbrella used to return to the owner a piece of bun which had fallen outside the cage, to be aimed again, and thus we have a combination of imitation and originality. These creatures have cross-bred, killed other bears, but per-

haps not acquired the art of suicide yet, unfortunately for themselves. It may be suggested that, if it is essential to keep these living pendulums in captivity, an obscure and inconspicuous site might well be chosen for their residence. The references to the tails of gorillas, chimpanzees, and ourang-outangs, that occasionally (together with other Simian details especially psychological) are reported, are traceable to menageries.

The leading museums require representatives of each species of bird's egg. The British youth who allows the fall of a coin to decide whether he shall make a collection of birds' eggs or postage-stamps, and then adjourns to the debate-room to recite the Kleinian replies, is a typical person.

The value of the observation of animals during life is now being recognised. Those who have access to the "Philosophical Transactions" should read the physiological paragraphs in the Kroonian lecture of Dr. Romanes and Prof. Cossar Ewart, on the "Locomotor System of the Echinodermata," and examine the elaborate accompanying plates. The individuality of the starfish arm was also investigated by these authors. The partiality of certain of these animals for light was ascertained, with other observations.

Cuttlefishes, snails, crayfishes, insects, &c., have been subjects of vivisection. This word is allowed a comprehensive meaning in this Article, including emotional pain on the one hand, and operation on "living" tissue, sentient or otherwise, "section" or no, on the other hand. It need scarcely be remarked that no exhaustive list of biological vivisections has been given here; numerous others could be cited in connection with Pangenesis and Hexicology. To prevent misconception it must be mentioned that the zoophilists have fully recognised the existence of physiological as distinct from medical experimentation, but, with a few instances as exceptions, have habitually conceived such physiology as is spoken of as the *Institutes of Medicine;* at the same time it is obvious that in Biology a physiology of *organs* supplements a physiology of *organisms*, and, for biological purposes, *vice versa* also.

Now we come to the point at issue: assume that the worth of future zoology depends to some extent, mainly or wholly, upon its experimental contributions, what step should be taken? Failure to secure opportunity for investigation in this country a specially English school might originate elsewhere, but those who watch the anti-vivisection movement know that the continental societies are becoming influential. Again, if the English bodies are successful will they

dissolve in their triumph after effecting total abolition, or send aid abroad? But every investigator may not have facilities to go abroad whenever he wishes to carry on research, and it may not be convenient for every English constant worker to reside there permanently. Therefore, if it be not wrong to vivisect for biological purposes, investigators should strive to obtain licenses to do so at home. Is it wrong?

The answer to this question brings us to a conclusion,—a conclusion to an Article endeavouring to show that this "Journal," having previously conspicuously treated of biological experimentation, ought not to relinquish its mission at the moment zoophily is awakening; and, secondly, that experimentation has much service to render to zoology in the future, and that it has rendered some already; indeed it is only from a judicious sense of my own untitled obscurity and incomplete knowledge that I refrain from expressing the opinion that every further step in comparative anatomy is a waste of time and an unrighteous sacrifice of animal life; but we have not yet found an answer to *the* question for zoologists and zoophilists (for one is as much a "scientist" as the other, for ethics is a science), viz., Is the need for the acquisition of knowledge calculated to furnish men and women with answers to these questions—Is Evolution Darwinian, sub-Darwinian (conditions, use, &c.), or Mivartian (psychogenetic)? is consciousness to be considered "*apart*" and as eternal?—sufficiently imperative to render expedient, *i.e.*, moral, the study of any biology involving the slaughter, and the captivity of, or the experimentation upon, the lower animals?

I have considered this subject during the month past, and constantly while writing this Article: my conclusions may be likened to the space occurring between this Article and the previous or one following in this "Journal." The subject should be discussed by any who happen to be more capable, and reflected upon by all it may concern.

II. ON TECHNICAL EDUCATION.

By ROBERT GALLOWAY, M.R.I.A.

(Continued from page 476.)

IN some of the previous articles we have shown how far behind other civilised countries England is at the present time in all that relates to a good school education suitable for boys intended either for trade, commerce, or manufactures; it remains for us to notice and discuss some of the efforts made by the State, through the Department of Science and Art, by the Universities of Cambridge and Oxford, and by the City and Guilds of London Institute, to improve the general and scientific education of the country, independent of, or in connection with, our Grammar and other Public Schools and Colleges which are supported either by private endowments or by Government grants. We shall also have to point out the absolute necessity there exists at the present time for the appointment of a special Minister of Education, charged solely with the over-seeing of educational institutions and of all matters relating to education.

The Department of Science and Art was established in connection with the Board of Trade in March, 1853, as a development of the Department of Practical Art; it was placed under the direction of the Committee of Council on Education in 1866. The grant it received in 1855 was £80,000; the grant this year amounts to £351,400, being a net increase of £18,369 on the past year's grant. The administration, in the form of salaries alone, will cost the country this year £8770; last year the grant was £8494.

The two Universities named established what are termed "Local Examinations" in 1858, for the purpose of supplying a common test of attainment for boys both in our public and private schools. In 1873 they enlarged the scheme by combining inspection with examination. The University of Cambridge commenced the organisation of a plan, in 1875, for promoting University teaching in populous towns, the object being to enable those who have left school, and are unable to proceed to a University, to continue their studies, by placing within their reach higher education of an accurate and methodical kind. The University of Oxford

has lately arranged to carry on a similar scheme. I am unable to state the amount that is yearly expended by the two Universities on these different educational projects.

The City and Guilds of London Institute has been established for the advancement of Technical Education; the Institute has been in existence about four years, and its Committee expended on the department of education it has been created to promote, in two years ending the 20th February, 1880, £25,205 17*s.* 1*d.* They intend to expend on the building alone of a Technical University, at South Kensington, £50,000; the site has been given by the Commissioners of the Exhibition of 1851. The Committee of the Institute are also expending, on a University building at Finsbury, £50,000, and an additional sum of £5000 on laboratory extension at their Middle Class School in Cowper Street.

We referred in the article in the March number to the recent appointment of a Royal Commission to inquire into the methods adopted in Germany, France, and other continental countries, for imparting Technical instruction: since that appointment was made Mr. T. Armstrong and Mr. H. Bowler—the Director and Assistant-Director for Art of the Science and Art Department—have been instructed by the Lords of the Committee of Council on Education to visit the Art Schools of Germany and the Industrial Exhibition at Nuremberg, and to prepare a Report on German Art-teaching. And the Royal Commission on Technical Instruction have appointed Mr. H. M. Jenkins, the Secretary of the Royal Agricultural Society, to act as their Sub-Commissioner, to inquire and report on the present state of agricultural education and the courses of instruction given in agriculture at schools and colleges in Denmark, Holland, Belgium, France, and Germany, and they have also commissioned him to report on the present position of agricultural education in England. And not many years have gone by since our Consuls at the different continental countries were ordered by the Government of the day to draw up Reports, which were afterwards published in the form of Blue Books, on the systems of Technical instruction carried out in the different countries to which they were attached. In addition to all the information on the state of modern education in foreign countries which has been obtained and published at the expense of the nation, very valuable contributions on the same subject have been published by private individuals at their own cost.

Along with the vast mass of evidence that has been al-

ready collected by various English agencies on continental schools of every kind and continental methods of instruction, we have also the benefit of the opinions of eminent foreign educationists—as Dr. L. Wiesse, late Privy Councillor in the Ministry of Public Instruction in Prussia, on our educational institutions and systems. Dr. Wiesse has made a personal examination and inspection of our institutions on two different occasions; his last visit was in 1876, his previous one in 1856: his personal acquaintance with our educational systems and institutions, combined with his great practical experience of the educational systems and institutions in his own country, ought to render the opinions he has expressed with regard to our own, and which have been published in England, of very great value to us.

Whatever may result from the labours of these recent Commissions which have been appointed to inquire into the art and scientific teaching in continental countries, the necessity for these inquiries cannot be owing to a lack of knowledge, for we have abundance of information on these subjects. Too often it is to be feared Commissions are appointed and their Reports are published more for ornament than for use; they appear intended only to silence for a time a section of the public on subjects which at the moment are inconvenient for the Government or some Government department. There is a curious instance of this in reference to the Intermediate Education question in Ireland. Mr. Wyse, in his zealous endeavour, as a writer on the subject in "Hibernia" states, to bring the question to an issue moved for a Select Committee to inquire into the actual condition of the Endowed Schools in Ireland, with the object of carrying out necessary reform. The Committee was appointed in 1835, and after *three years'* investigation sent in a voluminous Report, recommending complete reform and re-organisation, which the collected evidence showed to be sorely needed. The Government received the Report with their characteristic apathy, and after the question had been shelved for forty years the Endowed Schools were subjected again to the *inquiry* of a Committee, starting on the same lines, collecting the same evidence in some instances, examining the same persons, and subsequently publishing the same stereotyped facts which astonished and amused our grandfathers. And the question has not even yet been settled.

It is continually stated by most of our scientific authorities, both in their public and private positions, that we are still far behind continental nations in scientific and technica

education: this forms the *alpha* and *omega* of the speeches of our scientific men when they refer to education; it formed the note of lamentation in the opening address at the commencement of the winter session (1880) of the Society of Arts, delivered by Sir F. J. Bramwell, Bart., Chairman of the Council of the Society, and Vice-President of the City and Guilds of London Institute. The appointment of the Royal Commission to inquire into the subject is a tacit admission of the fact; and the admission is still further endorsed by the Lords of the Committee of Council on Education, for it is evident they think there requires such a thorough investigation into the Art-teaching in Germany, in order to improve the Art-teaching in this country, that it was not to be expected that the Director and Assistant-Director for Art, of the Science and Art Department, should themselves defray the expenses incurred by the inquiry, as they would naturally have done if they simply visited that country to add to their own knowledge of Art-teaching; and therefore the cost must be borne by the nation. Yet all who take an interest in education must or ought to be aware of the reasons which cause German education to be so superior to our own. We will notice in the next article some of the essential differences in the education of the two countries.

The non-success on our part does not arise from the State not supplying sufficient money for the purpose; for if we take a survey of the expenditure on the various educational institutions and schemes, the only conclusion that can be arrived at is that, if the expenditure of money was all that was required to obtain success, we ought to have the best general, scientific, professional, and technical education of any country. When we acquaint ourselves with the amount of money that is expended on education in the United Kingdom, we must all confess, I think, with Dr. Wiesse, that "the results are glaringly disproportionate to the *enormous sums spent* upon the education of young Englishmen; there is no department of human energy in which there is such a portentous display of power with such a *beggarly* amount of result." Again, the same high educational authority observes, with regard to our unorganised educational system, "If we except the elementary schools, public instruction in general does not in any way show a progress towards objects clearly recognised and defined. *An extraordinary amount of power, time, and money is still wasted from a want of plan and unity.*" Our expenditure is so excessive on occasions that we have sometimes to forego what more economical nations can undertake: the management of the English Department

at the International Exhibitions, which has always been entrusted to the permanent officials of the Department of Science and Art, affords a very good illustration of this. Sir H. Tyler, M.P., in the House of Commons, on March 1st, 1881, asked the Secretary to the Treasury whether any, and if so what, arrangements had been made to afford facilities and meet the requirements of British exhibitors at the then forthcoming International Exhibition of electrical apparatus at Paris. The late Lord Frederick Cavendish, Secretary to the Treasury, said it was not intended to appoint a Commission for the purpose named. Past experience in connection with international exhibitions of a general character had shown that there was no kind of expenditure more difficult to keep within bounds. The expenditure incurred had varied between the limits of £28,000, spent in connection with the exhibition at Vienna, and £115,000, spent on that at Paris in 1867.

(To be continued.)

III. ANIMALS AND THEIR DIET.*

CERTAIN facts which have recently come before the public are drawing attention to the question "How did animals first become carnivorous?"—a subject which is the more interesting as it naturally blends with the so-called "Vegetarian" movement. In taking the matter into consideration we must first cast aside two words which enable men to mystify themselves and their fellows. I refer in the first place to the term "carnivorous." This word is sometimes applied to beings which feed on animal matter in general, but it is, perhaps, oftener restricted to such as prey upon the larger animals. Thus some persons would assert that a creature which devours merely worms, snails, insects, &c., is not carnivorous, and in fact zoological systematists have given the names Insectivora and Carnivora to two

* How Animals became Carnivorous. By T. R. ALLINSON, L.R.C.P. (In "Field Naturalist" for August.)

distinct mammalian orders. Others would maintain that an animal which feeds upon the eggs of birds is not on that account carnivorous, since eggs are not flesh. To get rid of all this confusion we must for once "do the thing our soul hates," and propose a new word. Let us call creatures which feed upon animal matter, of whatever kind, zoophagous. With the vegetable feeders there is a somewhat similar confusion. It is not strictly accurate, *e.g.*, to call a being which lives on fruits or seeds "herbivorous." Hence it is the safest to speak of all animals which feed upon vegetable matter as phytophagous—a term already in use.

This being then understood, we turn to the subject itself. If, as every one must admit, plants came into being upon our globe earlier than animals, then, as Mr. Allinson contends, the first forms of animal life must have nourished themselves upon vegetable matter. Hence the question when and how animals became zoophagous is perfectly legitimate.

But at the same time we must recognise that among vertebrate animals, and especially among Mammalia, the earliest forms seem to have been zoophagous. Among fishes, amphibians, and reptiles, even in the earlier geological epochs, the vegetable feeders are found in a minority. The earliest birds—such as *Archæopteryx*, *Hesperornis*, *Ichthyornis*, and *Apatornis*, which approach nearest to reptiles, and which were probably all armed with teeth—were plainly fitted for a predatory life. Among mammals the lowest and earliest forms are decidedly zoophagous. This is the case with the monotrematous genera *Echidna* and *Ornithorhynchus*, and also with not a few of the marsupials, both recent and fossil. The oldest of the true placental mammals are the Insectivora, including the hedgehog, the shrews, moles, &c. Yet few of these animals partake of vegetable food, save under the pressure of necessity. Nor do they by any means confine their depredations to insects. The hedgehog merits the favouring notice of man as being a destroyer of vipers, but at the same time it excites the wrath of the sporting world by its raids upon the eggs of the pheasant and partridge, and even upon the young birds and upon leverets, and is, for his size, as clearly a beast of prey as is the tiger.

It may even be permissible to ask whether among the mammals the purely phytophagous forms have not been developed from a zoophagous, or at least from an omnivorous, stock? The only large group which, according to our present knowledge, contains no zoophagous or omnivorous members, is the old order Ruminantia. Now this sub-order,

which is first traced in the Eocene Tertiaries, is characterised by its complicated and highly specialised digestive organs, evidently modified from the normal mammalian type, so as to be adapted to a purely vegetable diet. This same structure, or at least one highly similar, is met with again among the sloths, the only phytophagous section of the Edentata.

The next consideration is that numerous animals which are zoophagous at one epoch of their life may be phytophagous at another, whether earlier or later. This change is not accidental or compulsatory, but ensues naturally and normally in every individual of the species in question. Thus all mammalian animals, whatever may be their future diet, begin life as zoophagous beings so long as they are nourished on their mother's milk. Indeed it is fully proved that, *e.g.*, the human infant is for some time incapable of digesting vegetable matter.

Among birds we meet with the same fact. Setting aside the many groups which are zoophagous throughout life, we find that, as a rule, the young of the seed- and fruit-eating species require an exclusively animal diet, consisting of insects, worms, &c. In other cases they are fed with half-digested food disgorged from the crop of their parents. There are few, if any, cases where a bird when just hatched is able to feed on crude vegetable matter.

Among insects many similar changes take place. The robber-flies of the genus *Erax*, which in their adult state destroy numbers of hive-bees, feed when larvæ upon vegetable matter. Not a few butterflies will sip the juices of dead animals, though in their caterpillar stage they are purely phytophagous. The larvæ of the hive-bee are fed upon honey and pollen, without any accompaniment of animal matter. But when mature they may be styled omnivorous, as, in addition to honey and juices of fruits, they are found to lick meat in butchers' shops, and even, according to Fritz Müller, to imbibe excrementitious liquids, as do also the butterflies.

Changes arising from a scarcity of food, or from caprice, are also on record. The two Carnivora which have become domesticated often partake of vegetable matter. The cat is even known to steal raisins and dried plums, and, according to Mr. Bates, in Brazil it goes into the woods to eat the fruit of the Tucuma palm. But amongst wild animals a change of diet when it occurs is almost invariably in the opposite direction, *i.e.*, from vegetable to animal matter. Under this head must figure the well-known case of the

sheep-eating parrot of New Zealand, the outbreak of cannibalism in an aviary of parrots recorded by Dr. Buller, and the zoophagous tastes recently developed by baboons in South Africa, who, according to Mrs. Carey-Hobson,* sometimes kill and devour sheep. These instances show that the habits of animals are not so fixed as was formerly imagined. They have their preferences, and their digestive organs may be better adapted for one kind of food than for another. But with few exceptions they will not starve, and if what may be called their natural food is wanting, or is scarce, they take any substitute which presents itself. Curiously enough, when any species has thus adopted a new diet, it shows a disinclination to return to its former food.

We have next to consider that the majority of warm-blooded animals are omnivorous, in so far that they consume both animal and vegetable food.

Thus, beginning with the Primates, it is a great mistake to assert that the apes and monkeys are purely vegetarian in their diet. They never omit an opportunity of robbing a bird's nest, and they feed with avidity upon a great variety of insects from fleas upwards. The lemurs are, if anything, a shade more inclined to animal food than the true monkeys. Even amongst the Carnivora we find not a few which vary their diet more or less with vegetable matter. Thus the bears and their allies, with the exception of the so-called Polar bear, seem to prefer fruits, roots, honey, insects, and even grain before it is quite ripe and hardened. The Viverridæ also include some fruit-eating members, such as the civet-cat. There is no satisfactory evidence that any of the cats in a wild state will consume vegetable matter, but at least two groups of the Canidæ—the foxes and the jackals—are not averse to fruit.

Among the Rodents an omnivorous character is becoming more and more fully established. The squirrels, in addition to fruits, nuts, and grain, greedily devour eggs, nestling birds, and insects; the hamster, the so-called Norwegian rat (Waterton's Hanoverian, but which might be better styled the Russian), even the common mouse, and indeed all the true Muridæ, are omnivorous. We have little doubt but when the habits of the remaining Rodent groups are thoroughly known, it will be found that they all, in addition to their vegetable diet, prey upon insects, worms, and mollusks, if not upon more highly organised animals.

Among bats the majority appear to be purely insectivorous,

* Knowledge, March 17th, 1882.

but the so-called fruit-eating bats—the Pteropidæ or flying foxes—although provided with a complex stomach and voluminous intestines, feed also upon such small birds and mammals as they can capture.

The Proboscideans, of which the elephants of India and Africa are the sole surviving representatives, are purely phytophagous.

Of the three divisions of the great order of the Ungulata, two—the Solidungula and Ruminantia—are, as far as we know, strict vegetarians; but among the Pachydermata we find the swine, which may be regarded as the most typically omnivorous mammals, and the hippopotamus. All the species of swine are eager for animal food. When grubbing in the earth they snap up rats, mice, snakes, insects, &c., and when opportunity offers they have been known not merely to attack but to devour much larger animals. A horse left tied to a tree, in La Plata, has been known to be killed and eaten by a herd of peccaries. The feral swine of North America have contributed much to the extirpation of the rattlesnake, and the common English pig often contrives to catch and eat up domestic poultry which stray into his stye.

Among the birds we find a very similar state of things. The number of purely phytophagous species is relatively smaller, that of the exclusively zoophagous larger, and that of the forms recognised as omnivorous is increasing as our knowledge of their habits extends. Who, for instance, would, either from the morphology or from the general propensities of vultures, have predicted what has been observed by Mr. Bates, that these unclean birds devour eagerly the fruit of the pupunha or "peach-palm" (*Gulielmia speciosa*), and "come in quarrelsome flocks to the trees when it is ripe"? The common peacock is called a granivorous and fruit-eating bird; so it is, but at the same time a zealous and efficient destroyer of young death-snakes. Hence the way in which it is shot down by certain blundering sportsmen in India is nothing short of a public calamity. The pheasant is such an eager devourer of wireworms, grasshoppers, and the like, that his extirpation, as threatened by blundering "anti-sportsmen,"—if we may coin the term,—would be a very doubtful benefit to the farmer.

The Merulidæ—the thrush, blackbird, fieldfare, and their allies—occasionally evince predatory habits, especially in severe weather. The most purely phytophagous birds are the finches (many of which, however, feed their young upon insects) and the doves.

We now see that the zoophagous and phytophagous forms of animal life are not separated from each other by any sharply-marked characters, but are connected by a multitude of creatures intermediate in their organisation, and consequently adapted for a mixed diet. We see that animal food is regularly, and in considerable proportion, eaten by species not constructed on the typically zoophagous type as witnessed in the tiger or the polecat. Yet such species as we may infer from the very fact of their existence are not thereby injured.

We know that the great mass of vegetables, especially the leaves, stalks, and even the roots and the fleshy part of the fruits, are less nutritious than is ordinary animal matter. To this rule the seeds of a number of plants, such as the legumens and the various kinds of grain, form an exception, though even here it would appear that a part of the nitrogenous matter is not present in a state suitable for assimilation. In other words, it exists not entirely in an albumenoid but in an amidic state. Hence we must conclude that an animal which is to exist entirely upon a vegetable diet must have larger digestive organs, so as to operate upon the greatest quantity of matter at once. On the other hand, purely zoophagous species require, or at least can exist with, a smaller and simpler digestive apparatus. We may go a step further: of all nutriment the poorest—*i.e.*, that which contains the smallest quantity of blood-forming matter—consists of leaves and stalks. Accordingly the Ruminants, which feed upon leaves and stalks, have the largest and most complicated stomachs. In the Solidungula, of which the horse and the ass are typical specimens, the diet is the same as that of the Ruminants, but the stomach is simple, and digestion is in consequence far less perfectly performed, as an inspection of the respective excrements of the horse and the ox will readily show. May it not be that we have here the reason why the Solidungula as a sub-order are so far less rich in forms and less widely distributed? We come now to such animals as the swine. Here the divisions of the stomach occurring in the Ruminants are but faintly marked out, to suit a richer diet, composed largely of roots mixed with no inconsiderable proportion of animal matter. A step further we find the apes feeding on fruits and nuts, with the addition of eggs, larvæ, &c. Here the stomach is simple, and the whole digestive apparatus lighter in proportion to the entire body than that of the swine. Lastly, in the true Carnivora, where the diet is most concentrated, we find the digestive canal shortest,

and the relative weight of the stomach and its appendages smallest.

Another point of difference between animal and vegetable matters is that the former require less preparation before they can be assimilated. Hence we find that the teeth of the dog or cat, besides their action in seizing and killing the prey, need merely to tear it into lumps of a convenient size for swallowing. When this is once done digestion is not difficult. Vegetable food, on the other hand, requires to be ground to a pulp, so that the saliva and the gastric and pancreatic secretions may act upon its smallest particles. Hence true molar teeth are required, destined not to cut, but to pulverise. We see an approach to this structure even in the bears. But for the poorest kinds of vegetable food this arrangement is not sufficient; the leaves and stalks eaten, consisting as they do largely of cellulose,—which man cannot digest at all,—have to go through that double preparation commonly known as chewing the cud.

We may now venture to assign a reason why it is easier for a phytophagous animal to turn zoophagous, than for a zoophagous creature to become phytophagous. A lion, or even an ape or a man, could not take into his stomach so much grass as would afford him sufficient nourishment. Not having the teeth of the ox or the sheep, and not being able to ruminate, he would fail to digest the grass in any degree even approaching to perfection, and he would soon perish from hunger, as not a few men have done who in times of famine have tried to support themselves upon grass and leaves.

But an ape, a rat, or a swine experiences no difficulty in digesting animal food.

Man approaches at least as near—probably nearer—to the pure zoophagous type as do the rodents and the swine. He has three kinds of teeth completely covered with enamel; his digestive apparatus weighs less in proportion to his entire body than does that of the swine, thus pointing to a more concentrated diet. Hence we should be inclined to consider that man is at least as naturally and originally omnivorous as the Rodents or the Suidæ. It has been contended that his "carnivorous practices have not yet changed his nature." Why should they more than has been the case in other omnivorous forms? If sharp nails, projecting canines, and a rough tongue would have given man any advantage in the struggle for existence, doubtless they would have been evolved. But these points do not in the least tell upon his power to assimilate animal matter.

His intestine, though of greater relative weight than that of the pure zoophagous species, is evidently required for his present mixed diet, and hence it persists.

IV. THE FOUR FORCES IN NATURE.

By George Whewell, F.I.C., F.C.S.

IN a previous article* we ventured to enunciate a theory to explain the fact that the same piece of carbon (or any other element) in different states of combination had in one case the power of motion, and was what is called living matter, and in the other case had not the power of motion, and was what is called dead.

In Nature we recognised four forces, which we ventured to call atomic viva, organic viva, animal viva, and mensic viva (mind).

The same piece of carbon, in one condition having no power of motion, as when forming a portion of the root or stem of a plant, possesses atomic and organic viva. When it forms a portion of a nerve it possesses atomic, organic, and animal viva; and when it forms a portion of the brain, and causes man to think and act, it possesses all the four forces,—atomic, organic, animal, and mensic (mind) viva.

We assume that the elements contain these four forces in a state of activity or otherwise, according to circumstances. When the element belongs to the mineral kingdom it possesses only atomic viva, the other three forces being latent. When it belongs to the animal kingdom the other three are either active or latent, according to circumstances,—that is, according to the position they occupy in the body of a living animal or plant.

Take the life-history of our theoretical molecule of carbon. Suppose that a molecule of carbonic acid gas floats about in the atmosphere, and is driven hither and thither at the caprice of every wind that blows. In this condition atomic viva is alone active, the other three being latent. In its

* Journal of Science, October, 1880, p. 639.

passage over the earth it strikes against the leaves of an edible plant; the sun is shining, and the molecule of carbonic acid gas is absorbed by one of the leaves of the plant; the carbon is retained, and the oxygen is given off again. The carbon becomes a portion of the substance of the plant. It has changed its condition from being a portion of a poisonous gas to be nutriment for man or animals. From being a portion of dead matter it becomes a portion of living matter. The gardener takes the plant, cooks and eats it; by-and-bye it is converted into blood, and is then in a condition to have its latent forces developed. It can become a portion of a muscle, and possess atomic, organic, and animal viva, and be a portion of a living body. It can become a portion of the brain, and produce thoughts—violent, demoniac, or sublime—at its own caprice. In this condition it possesses all the four forces in a state of activity. When it has produced these effects it again becomes carbonic acid gas, and finds its way into the outer world to be tossed hither and thither at the mercy of the winds.

This same molecule of carbonic acid gas may go through this endless change from century to century.

New forces must of necessity develop, and become latent, in the molecule in passing and re-passing through this endless variety of changes.

V. FRENCH REACTIONISM IN SCIENCE.

IT might not unnaturally be supposed that in nations, as well as in individuals, the leading traits of character would be equally manifested in all departments of activity. We might, *à priori*, expect that persons bold and energetic in outward matters would display the same features in the realms of thought. This is not so. Dr. Beard has shown, in a work touched upon in our issue for last month, that two nations, physically and morally courageous, are intellectually timid. A similar, and perhaps even more striking, case of national inconsistency requires our present notice.

All authorities, from Julius Cæsar downwards to our own days, agree that in their private lives, as well as in public affairs, the French can by no means be charged with a blind and obstinate adherence to existing institutions: on the contrary, a fondness for novelty merely as such, a love of change, and a hope that such change will prove a remedy for inconveniences and evils in general, are generally considered to be with them ruling and deeply-rooted principles.

Hence it is a matter worthy of inquiry if we find this fickle and volatile people, commonly so called, resisting changes which their graver and more sedate neighbours across the Rhine and the Channel have seen fit to accept.

This exceptional adherence to the past is shown by the French in Science, and it has been recognisable from time to time for about two centuries. It was first distinctly manifested in the opposition shown to Harvey's discovery of the circulation of the blood. The announcement of this fact —although, as the anti-vivisectionists tell us, it was no novelty—was obstinately rejected by Riolan, probably at that time the most learned and influential physician in France, and by not a few of his colleagues and countrymen.

A far clearer and more striking case is the reception accorded to the Newtonian reforms in astronomy and physics. Bernouilli and d'Alembert repudiated the theory of universal gravitation.

In short, France may be said to have remained at heart Cartesian almost to the end of the last century, the new system—as Mr. J. B. Stallo well expresses it—finding adherents "slowly and reluctantly."

Turning to another science, it is well known that the greatest change in modern physics has been the rejection of the theory which regarded heat, light, electricity, and magnetism as so many kinds of imponderable matter, and the acceptance in the stead of the mechanical doctrine which views these great natural agencies as modes of motion. Now we do not mean to deny that the modern doctrine is accepted and taught in French seats of learning. But for all this the ghosts of the "imponderables" still haunt French lecture-halls and works on popular science. "Caloric" especially seems hard to exorcise.

Perhaps it may be suspected that the opposition to the above-mentioned innovations is the outcome of a mistaken patriotism.* Harvey was of course an Englishman; so

* *Pure* Science is cosmopolitan. But we doubt whether an inventor in technical chemistry, and a nominally scientific traveller whose real functions are those of a military spy, should be honoured by the nation which they are seeking to injure.

also Newton, and the latter, in addition, was overthrowing the work of the great Frenchman Des Cartes. The reformers in physics, also,—Clausius, Meyer, Joule, Helmholtz, Rumford, and Davy,—were none of them natives of France. To set aside this supposition we must refer to cases of change in which French genius has been largely concerned, and which have yet experienced in France an unkindly reception.

We take first the inauguration of the so-called "new chemistry," involving the rejection of dualism, the recognition of substitution, and of the doctrine of atomicity. These views, with the corresponding changes in notation and nomenclature, are all but universally recognised in England, Germany, Italy, Russia, and America. An elementary treatise which should ignore or reject the more recent views would in England be useless, since a knowledge of these views is obligatory upon all examinees in chemical subjects. A paper read before the Chemical Society, in which the notation and the theoretical views found, *e.g.*, in the Cavendish Society's edition of Gmelin's great work, were employed, would be received with amazement almost as blank as if the reader were to revert to the language and ideas of the pre-Lavoisierian epoch, and to account for phenomena by the presence or absence of phlogiston. In Germany it is expressly demanded that the language and the symbols (if any) employed in the specification of a chemical patent must be in accordance with the present state of knowledge. In America the nomenclature of the "new chemistry" has actually found its way into the workshop and the market.

But in France the state of affairs is altogether different. In treatises written by eminent chemists, and in memoirs written before the Academy of Sciences and duly printed in the "Comptes Rendus," we may still find, *e.g.*, the symbol for water written HO.

Now it is certainly true that what is by some authors now spoken of as the "old chemistry," with its accompanying notation and terminology, was to a great extent established by Lavoisier and his friends, and was hence for a time even called "la chimie Française." But, on the other hand, the system now in the ascendant owes perhaps more to France than to any other country, as we shall admit if we duly estimate the labours of Dumas, Laurent, Gerhardt, Ampère, and others. So that the slow progress, and the very partial acceptance of the new chemistry in France cannot be in any marked manner traced to national jealousy.

We come now to a far wider and deeper change in Science

than any of those we have just considered, the Newtonian movement not excepted. When Darwin resuscitated and established the doctrine of Organic Evolution he met with eager and powerful coadjutors and allies in almost every civilised country. The master-minds of Germany, Holland, Italy, Austria, flocked to the standard of Development, and soon furnished splendid contributions to the evidences of the new truth. In America Darwin experienced the same general welcome, save from Agassiz, *a Franco-Swiss, deeply imbued with French traditions*. France alone, among all nations of high culture, took up a hostile position. It is true that many French naturalists admitted the importance of studying Nature in the light of the new revelation; but the leaders of French Science, the Scribes and Pharisees of the Academy, the Museum, and the University, would have none of it. The Academy of Sciences formally rejected Darwin, and it must not be forgotten that in the official eulogium delivered on occasion of his death before that august body, by M. de Quatrefages, this rejection was not recanted, deplored, apologised for as an indiscretion and an error, but upheld and justified as an act of dignified and judicial impartiality! It may be here said that Evolutionism and its modern champion have been opposed and denounced in other countries no less than in France. True, but by whom? Darwin's English, German, and American opponents were clergymen, lawyers, historians, poets, cultivated men of the world, without any special acquaintance with the natural sciences. The French hostility to Evolutionism centered in the learned institutions, and was presided over by biologists!

Here as little as in the case of the recent reform in chemistry can we trace the cause to national jealousy. Darwin and Wallace were of course Englishmen, but in the last age France had contributed nobly, by the hands of Buffon, and especially of Lamarck, to the foundation of the new natural history. It would have been open for the Academy of Sciences, with a little exaggeration, to have claimed Evolutionism as "la biologie Française," and to have pronounced Darwin merely a successor of Lamarck. Some French writers have adopted this view, but that the leaders of French science should prefer to reject Evolution altogether is a problem of some interest.

Some persons—including a writer in this Journal—suggest that the cause of the peculiar attitude taken by France in view of Evolutionism, and generally of great scientific reforms, may be ethnological. The Celt, they tell us, lives in the past as essentially as the Teuton does in the future.

The former broods over and tries to revive former conditions, real or imaginary, whilst the latter, "unhasting and unresting," makes preparation for days to come. On this supposition old theories should be upheld in France rather than in Germany, and in Ireland and Scotland more than in England. In this connection we are reminded that many of the most prominent anti-Darwinians in the United Kingdom are, judging from their very names, of Celtic origin. But in opposition to this ethnological hypothesis we must remember that the French, in matters other than scientific, are by no means apt to reject what is new simply on account of its novelty.

One theory then remains: France is averse to new discoveries because in her, more than in any other country, Science has assumed an official character, and is practically under the control of an oligarchy. Such bodies, whether national, municipal, ecclesiastical, or literary, have in all ages and in all countries been noted for an unreasoning conservatism—if we may venture here to use so ill-defined a term—and for jealousy of outsiders. The Academy of Sciences has most of these unpleasant features. The number of its members is absolutely fixed, and no merit can open the door to a candidate until there is a vacancy. The election of a member requires to be confirmed by the head of the State, be he emperor, king, or president. The Academy is the especial scientific adviser of the Government; it has the task of awarding a great number of prizes which have been given or bequeathed for merit in various branches of science, or for eminent discoveries and inventions. In other respects it possesses, directly or indirectly, a great amount of patronage. If a college professorship or a curatorship is vacant, the opinion of the Academy generally decides the appointment. If a scientific expedition is to be set forth, the selection of the explorers rests practically with the same body. It stands, too, alone. The other scientific societies of France are comparatively powerless and uninfluential, and never even attempt to question the doings of the Academy. Indeed to do so is in many quarters considered as exceedingly "bad form." It will be perceived that such powers as are conceded to this learned body are exceedingly liable to abuse. Unless its members are actuated purely by the love of truth they will scarcely be able to resist the temptation of using their influence for their own aggrandisement: hence an outsider—a young and unknown man, or a foreigner—has no small difficulty in securing a fair hearing. If he has made investigations which do not

clash with the results obtained by any academician, and if he shows a due amount of deference, all may be well. But how is he to secure fair play if he has run counter to and refuted theories to which some academician stands committed? It may, indeed, happen that in some branch of science the illustrious body in question may include two rival luminaries. In that case the outsider, if he has been overlooked by M. le Professeur A, will find in M. le Professeur B a most zealous champion, and by thus playing off the Montagues and the Capulets against each other he may obtain recognition. But it may happen that in some one department there is an autocrat, a man less noted for the brilliance of his discoveries than for the perseverance and energy with which he has fought for power and influence. How will the outsider fare in the French scientific world if he has overturned the theories which this man has all his life striven to conserve? This was precisely the fate of Darwin and of Evolutionism before the judgment-seat of French official science. They must be ostracised by those who, as far as biology is concerned, have striven, and successfully striven, to cramp up the intellect of France in the straightest doctrines of Cuvierism, and to keep French youth from sharing in the onward intellectual movement of the rest of Europe and of America. That their brother immortals raised no objection need not surprise us; they merely acted like the ancient Roman triumvirs in settling a proscription-list:—"Allow me to condemn Darwin, and I will do as much on occasion to oblige you!" We understand, now, surely, the reactionary spirit which has been so often manifested by French science. It is but the natural working of centralised officialism.

Germany presents a totally different picture. There no one learned society stands in especial connection with the State, and is enabled to dominate all others. Every university is an independent centre of intellectual action. There is that fulness, that variety, which we always recognise in vigorous life.

In England, Science, if not subsidised by Government, has been free from control, and herein has been its salvation.

Will it retain this freedom, or will it fall into bondage to a centralising bureaucracy? The danger with us is not, we must remember, from the Royal Society, but from a totally different body, which we fear aims at powers wider far than those possessed by the French Academy.

VI. FASHIONS AND EVOLUTION.

By D. Y. Cliff.

BY "Evolution" I intend in it the sense of "alteration," one way or another. All of us are often struck with the partially vain efforts of old women "to look young," and the wild despair that refuses to be called "old," nay, nor yet "middle-aged," until they are too hideous even to behold themselves. Our *great* Elizabeth shrunk horrified from her glass many years before she died, and indignantly ordered the too faithful coin-die to be destroyed. We feel assured that Eve herself must have wept over her departing charms.

All this perseverance, mental and physical, for countless ages must have had a very definite effect on her progeny. May it not be seen in the very brutes? If these fits, it be said, do only come on in later life, it cannot be denied that they are in full activity in the mother.* It is a very familiar fact what a marked effect the thoughts, &c., particularly the terrors, of a parent have on the child unborn.

Then, perhaps, it is more than a vague theory to argue that this vain tendency in woman (and man for that matter) is really "a great and lasting benefit" to humanity: with Bentham we can say it "enables a greater number to live happier," &c.—in a word, improves the "human face divine." This being a "fault" of man's too (howbeit in a smaller degree) the whole human race is rendered handsomer and more agreeable to look upon for a longer period of life: many other effects necessarily follow therefrom. One would say that the foot of a Chinese lady, naturally grown, would be smaller than ordinary where it was a family practice. I am inclined to think, from an inspection of engravings† of old Greek statuary, that our modern "thin waist" (as now understood) amongst females is the result of fashion, and that from even so late in the world's history as the earliest civilisation in Greece, and maybe in Egypt. Nay, the tapering may be almost said to be outwards and downwards from

* Some hold that the children of elderly or old parents are handsomer than those of younger ones. Is there even a partial truth in this? (Of course other items step in as well.)

† My source is "The Pictorial Gallery of Arts," vol. ii., 1847.

under the arm-pits to the hips.* Was it only the idle fancy of the sculpturer, in direct variance with fact? Had the bevy of young ladies who formed Zeno's models of Venus all this "fault"? In her loose elegant garb the girl of ancient Hellas could expand and develope naturally; we do not suppose the "virgin cord" would be drawn very tight. Look at the figure of "Venus, from the baths of Claudius"† —the uplifted arm gives the taper there. Nevertheless, though they seem straight, or even outwardly tapered, it must be admitted that the tendency to a thin waist is there, though very remote from the modern "eighteen inches round, my dear"! Mr. Park Harrison, M.A., in a recent paper, would seem to throw considerable doubt on the veracity of these figures as representing the Greek proper of their day.‡ If we will now consult engravings of modern art§ I think we shall be at once struck with the (unconscience?) production in accordance with modern taste: the waist is made decidedly thinner.

Thin waists are not uncommonly *natural* now-a-days, and may be the result of "fashion." It is well known how the cultivation, amongst savage tribes, of monstrosities—*e.g.*, thick and protruding lips, large ear-lappets, &c.—tends to "improve" them, although they would probably disappear speedily if neglected, "unless the variety became the species" through a majority of numbers: the permanency of the Hapsburg lip is notorious as well as creditable.

Again, according to the same statues, man always possessed a contracted waist, and possibly the distinction may have been exaggerated to give a more sensuous *livingness* to the stone "creations." There is an entire absence of the ugly breasts that disfigure the "savage breast" of a female (seen in Hindoo figures), nor is it imaginable that the ladies of Thebes or Athens ever wore "stays."

I cannot close these remarks without drawing attention to the fact how very *English* the busts of the most famous men of old look: observe them. Were they to rise from the dead and don the modern breeches they would pass unheeded even in our quietest villages. Imagine Julius Cæsar, Cicero, Aristotle, &c., with chimney-pots on their heads!

* *Ibid.*, *e.g.*, fig. 816, p. 228.
† *Ibid.*, fig. 803, p. 225. See also Figures of Venus, 846, p. 233.
‡ *See* Report of the British Association, 1880, p. 625, &c.
§ *See*, *e.g.*, The Illustrated Catalogue of the Exhibition of 1851, published with the Art Journal, pp. 2, 48, 151, 225, 234, &c.

VII. THE PALÆONTOGRAPHICAL SOCIETY.

By W. Jerome Harrison, F.G.S.

AMONG the Scientific Societies of Great Britain the *Palæontographical* must be assigned the first position, if we consider the results obtained in proportion to the amount of money expended. This Society was established in 1847 "for the purpose of figuring and describing the whole of the British fossils." No entrance-fee has to be paid, and there is no form of election to be gone through, but "each person subscribing one guinea is considered a member of the Society, and is entitled to the volume issued for the year to which the subscription relates. The thirty-six volumes that have been published contain an amount of geological information which may be in some degree realised from the statement that they include more than 10,000 large quarto pages of letterpress, in which 5019 species of fossils, including representatives of almost every division of the animal and vegetable kingdoms, have been described.

But a description of a fossil in words only is, as a rule, insufficient to a thorough comprehension of its nature and appearance; accordingly these volumes are illustrated by 1467 large plates, on which are 26,260 figures, executed in a style which may fairly be described as unsurpassed, if not unequalled.

It might have been thought that such a great undertaking as this should have been a matter for the Government to carry out, its execution being entrusted say to the Geological Survey, conjointly perhaps with the British Museum. But that is not how we do things in England; and let us be thankful that it was not so, or we should have suffered from the long delays, poor printing, and high prices which have characterised the publication of the Memoirs and Maps of the Geological Survey.

The thirty-sixth volume of the Palæontographical Society, just published, opens with a list of the 494 members belonging to the Society, by whose annual subscription of one guinea the expenses of its publication are defrayed. The first impression of any reader must be that the volume is by far the cheapest scientific publication he ever took into his hands; for the paper and printing are of the best, the writers

stand in the very foremost rank of science, and the plates are simply magnificent. The explanation lies in the fact, firstly, that no money is paid to the authors for their contributions, the work being entirely a labour of love on their part; and secondly, that the Society possesses in the Rev. Thos. Wiltshire a Secretary whose business qualifications are on a par with his high scientific acquirements.

The new volume opens with the final part of an account of the beautiful fossil ferns found in such profusion in the Eocene days of Bournemouth; next, Dr. Wright concludes his description of the 124 species of sea-urchins which occur in the chalk of Britain; the same palæontologist continues his account of the Ammonites of the Lias; Dr. Davidson gives another instalment of his grand work on the Brachiopod shells; and Mr. S. V. Wood adds a short supplement to his father's classical description of the shells which occur in the "crag" of Norfolk and Suffolk. A remarkable feature in this volume is the account given by the Rev. N. Glass, of Manchester, of the manner in which he has succeeded in working out, for Mr. Davidson, the internal "processes" and "spirals" which occur in the interior of Brachiopod shells. Thos. Davidson, Esq., LL.D., F.R.S., has been a great mainstay of the Palæontographical Society; he has devoted his life to the study of the Brachiopoda; he has drawn for the Society, with his own hand, on the stone, 8549 figures of these shells, besides writing 1785 accompanying pages of letterpress. Naturally his enthusiasm has communicated itself to others, for Dr. Davidson is ever ready to help the most humble student of geology. In the Rev. Norman Glass Mr. Davidson has found a coadjutor of unwearied patience and exquisite skill. In fossil shells we have, of course, only the hard parts of the animals preserved; now Brachiopod shells have internal "hard parts," in the shape of complicated spirals or projections, to which, during the life of the inhabitant of the shell, the soft parts were attached. These "spirals" still exist in the fossil shells, but, being completely enveloped by the hard, stony matter which fills the shell, their shape, and position were almost unknown until, in 1877, Mr. Glass discovered a means of laying them bare. He selects such shells as are filled with semi-transparent "spar," and by diligent scraping with the point of a penknife, aided by occasionally immersing the shell in dilute hydrochloric acid, he has made many most beautiful preparations, enabling Dr. Davidson to separate species that had previously been confounded on account of their external similarity, and even to establish several new genera.

Mr. George Maw, of Broseley, has rendered efficient aid by submitting about 20 tons of Silurian shale to the action of a potter's "blunging" or clay-levigating machine: when the fine clay was washed away Mr. Maw employed women to pick out the fossils from the *débris*, and obtained for Dr. Davidson, in this way, about 50,000 specimens of Brachipods! We recommend this plan to the notice of geologists in other parts of the country; a washing-tub and "dolly" would make a very fair substitute for the potter's machine.

In looking over the back volumes of the Society, the names of Prof. Owen, Mr. Searles V. Wood, Mr. J. W. Salter, Prof. Duncan, Dr. Lycett, and Dr. H. Woodward stand out prominently, while the list of articles "in preparation" includes the names of the best men of the day.

But when may we hope for the completion of this great work? Perfectly complete it can never be, for every year, as the rocks continue to be searched, new species turn up, which require to be figured and described; but when may we hope for the practical completion? The total number of known fossils from the British strata may be estimated at 15,000 species. If in its thirty-six volumes the Palæontographical Society has been able to give an account (as it has done) of 5000 species, it is clear that, at this rate of progress, we shall be half-way through the twentieth century before the entire work even draws near to an end. It is true that this is a work which cannot be *hurried*, but with an increased subscription list its completion might certainly be *accelerated*.

The stock of back volumes is but a limited one, and, although sets of them may now be had at a reduction, yet their value will be undoubtedly high in future years. Every local scientific society and every local library ought to possess a set, for to a working geologist these volumes are simply indispensable.

In the hope that many of our readers will use their influence in this direction, we give in conclusion the Secretary's address:—Rev. Prof. Wiltshire, M.A., F.G.S., 25 Granville Park, Lewisham, London, S.E.

VIII. SUNLIGHT.

WHEN we consider the countless ages that the sun has given out his daily light and heat, without our most delicate instruments being able to detect any loss in substance or energy, we are apt to conclude that there is something wanting in our theories to explain how such constancy is brought about.

The law of gravitation gave the key to what had been previously inexplicable in planetary motion. It showed us how mass was attracted by mass, and how world was influenced by world; but we seem to have altogether overlooked the force which must result from this universal attraction and this never-ending motion. Is it here that we are to seek for the force that builds up a sunbeam?

If we rub a glass rod with a piece of silk it becomes warm through friction, but independently of this its attractive properties are greatly increased, and it is found to emit light and heat when brought into contact with the earth. What has brought about this change? The answer is Motion. But motion alone would never have had these after effects unless there had been a prior mutual attraction between the two bodies. This imperceptible attraction was overcome by the motion, and the result was that the attraction was not only increased, but the surplus force appeared, in a spark, as light and heat.

If under peculiar circumstances one magnet is revolved in front of another, the same effects are observed, although in this case there is no contact between the two bodies. If we disturb the attraction which holds together the atoms of a chemical compound, whether it be in the solid, the liquid, or the gaseous state, we have this same emanation of light and heat. If, then, these great effects can be produced in our laboratories, what must result in our Solar System from the continual struggle between attraction and centrifugal force?

In our own system we find our glass rod replaced by a rolling world 882,000 miles in diameter, round which is continually circling a host of other worlds. Here there is no contact, therefore no friction to retard and disarrange the whole, but there is a mystic tie that binds them all together —there is, in fact, attraction. When this attraction is disturbed by motion the result must be as in our former

experiments, light and heat; and the chances are greatly in favour of such light and heat originating in a huge electric discharge. But as it would be difficult fo account in this way for all the heat received at the earth's surface, it is probable that the original discharge is comparatively cool, and that it becomes heated only when it encounters a resisting medium such as the earth's atmosphere.

Supposing sunlight to consist of an electric discharge, it is probable that on striking the earth's surface it travels over the whole of the *illuminated* side in a series of curves radiating as it were from near the Equator towards the North and South Poles, where, when the earth becomes fully charged, the discharge makes its escape, and appears to us as an Aurora or some other familiar phenomenon. The supposed direction in which the terrestrial currents travel may be well seen by sprinkling a small quantity of fine iron-filings on a piece of cardboard held over a bar-magnet. The two points where the lines of force converge will represent the north and south magnetic poles, and a line drawn equidistant from and at right angles to these two points will represent the magnetic equator, and the lines diverging from the outside of the poles the return current.

At first sight it would appear that this comparison was fallacious, as it is obvious that if the curves joining the two converging points were insulated, and an electric current passed from the outside towards the centre, or *vice versâ*, the effect would be not to form two poles, but only one, situated on the equatorial line. But if matters were so arranged that the current travelled in different directions, from the equatorial towards the converging points, the effect would be changed, and we would have two poles, one of which would attract and the other repel the north pole of a magnet.

If these latter speculations be correct we might be able to find an explanation of the secular, annual, and diurnal variations of the compass, on the assumption that such variations were caused by a slight change in the direction of the current, owing to the revolution of the earth, and also to the presence of induced currents on the non-illuminated side.

As the object of this paper is to present the speculations contained therein in a general form it will be unnecessary at present to go into details, but rather to try to prove shortly that the action of motion on attraction results in sunlight; and the most direct proof that can be brought forward will be found in the appearance that a comet presents in its approach to and departure from the sun.

According to the more advanced theories regarding comets, they are thought to consist of solid matter, and rigorously to conform to the laws of gravitation, and strictly to follow out their orbits. When a comet is far away from the sun it appears very much like ordinary stellar matter; but as it gradually approaches the sun, and as its motion increases, it becomes more brightly illuminated, and sends out short streaks of light sunwards. Shortly these streaks are forcibly driven back as by some repellent force, and gather about the head of the comet in a bright halo. On a nearer approach this halo appears to be partly thrown off, and one or more tails formed on the side away from the sun. When the comet sweeps round the sun its tail wheels round along with it, always keeping away from the sun, and as it recedes its tail—which is now in front—gradually dwindles away, until it appears as ordinary stellar matter again.

As comets (at least those that we have most to do with at present) travel in infinitely long ellipses, and strike the plane of the ecliptic at a considerable angle, they may be considered, for all practical purposes, not to participate in the general circular movement of the planetary system; and when crossing the plane of the ecliptic they will therefore be altogether stationary, and under the same influences as the sun himself.

Now let us follow a comet in its passage from outer space to this particular point. When it first makes its appearance we see it through our telescopes as a faint, hazy, undefined body, which appearance very probably results from a deficiency of power in our instruments. As it approaches the sun, short streaks of light spring forth sunwards, or rather an electric discharge passes from it towards the sun, owing to its having been formerly the rubber, and consequently endowed with a different kind of electricity. As it gets further within the influence that (according to this theory) forms a sun, a repulsive action takes place between it and the sun, owing to their now being charged with the same kind of electricity; in fact, for the time being, it becomes a sun, and emits light in the direction of the rubber, or outer planetary matter, in the same manner as the sun himself.

Throughout our statements we have been making use of these two powers, motion and attraction; but if these speculations be correct, attraction is but the product of the action of motion upon mass, in the same manner as light and heat are the outcome of the action of motion upon

attraction. It consequently follows that the one must balance the other, and that there is no immediate likelihood of our being drawn into the sun through the agency of a resisting medium, as any such retarding influence would have the effect not only of reducing our speed, but also of lessening the attraction.

R. LAMONT.

ANALYSES OF BOOKS.

The Scientific Evidences of Organic Evolution. By G. J. Romanes, M.A., LL.D., F.R.S., Zoological Secretary of the Linnean Society. London: Macmillan and Co.

This work is simply what it professes to be,—an epitome of the Darwinian doctrines presented in a clear and concise form, so as to meet the requirements of the busy and of the indolent. The author remarks the common "ignorance of the *Origin of Species* shown by many persons who can scarcely be said to belong to the uncultured classes." Nowhere, we may add, is this ignorance more dense than among the average hostile critics of Evolution. There still spring up from time to time men who, with no previous knowledge of any department of Biology, dip carelessly into the works of Darwin, Wallace, and their coadjutors, and rush forthwith into print with the grandiose aim, forsooth, of overturning the new Natural History and restoring the age of Cuvier. It would be well if such persons—and we have one of the class in our mind's eye—would condescend to read, patiently and candidly, Mr. Romanes's little book; they might arise wiser and humbler men.

The author sets out with an explanation of "natural selection," or the "survival of the fittest," as the inevitable consequence of that "struggle for existence" which everyone must admit to be raging around us. It is curious that a recent anti-Darwinian writer has assumed the three terms we have placed between quotation marks to be the names of three distinct principles.

It may, perhaps, be said that Mr. Romanes has scarcely been sufficiently careful to guard his readers against a common error, especially dangerous when the principle of natural selection is applied to social science. "The survival of the fittest" means, plainly enough, the survival of those creatures which are most in harmony with their surroundings. Were this point kept in view there could be no misunderstanding. But such expressions as "The *strongest* will be victorious," "Nature selects the *best* individuals," "Only the *flower* of the race is allowed to breed," &c., are, to our certain knowledge, misinterpreted to mean the strongest or best in some abstract sense. Now there can be no doubt that certain extinct Carnivora would in fair fight vanquish any surviving species. Nor, passing to another plane, can we deny that the men who fail in life are often better, both physically and intellectually, than the men who succeed. But the former are less in harmony with a foul social atmosphere.

Another important consideration which Mr. Romanes brings forward in his Introduction relates to the "design question." Not a few persons—even those of high, though not scientific, culture—are apt to argue "the fact that these innumerable cases of adaptation may be accounted for by natural selection is no proof that they are not really due to intelligent design." The author justly contends that this objection involves a "radical misconception of the whole logical attitude of Science." The principle called by Sir W. Hamilton the "law of parsimony" forbids us to seek for higher causes when lower ones are adequate to explain the phenomena observed, and this law, as Mr. Romanes pointedly observes, is "the only logical barrier between science and superstition." For if phenomena are to be referred to the immediate operation of some supernatural agent, Science becomes impossible.

Mr. Romanes draws, however, a distinction which is too often lost sight of. In rejecting, in our opinion with perfect right, the teleology of Paley, Chalmers, and the Bridgewater essayists, he makes a reservation in favour of a higher form of the theory of design. He writes—"I hold that Mr. Darwin's theory has no point of logical contact with the theory of design in the larger sense, that behind all secondary causes of a physical kind there is a primary cause of a mental kind. Therefore throughout this essay I refer to design in the sense understood by the narrower forms of teleology, or as an *immediate* cause of the observed phenomena. Whether or not there is an *ultimate* cause of a psychical kind pervading all Nature, a *causa causarum* which is the final *raison d'être* of the Cosmos, this is another question, which, as I have said, I take to present no point of logical contact with Mr. Darwin's theory, or, I may add, with any of the methods and results of natural science."

The author, having thus cleared the way, goes on to present in succession the various kinds of evidence for Organic Evolution.

First comes the argument from classification. Here we find mention of a "very comical disquisition in one of Buffon's works on the question as to whether or not a crocodile was to be classified as an insect; and the instructive feature in the disquisition was this, that although a crocodile differs from an insect as regards every conceivable particular of its internal anatomy, no allusion at all is made to this fact, while the whole discussion is made to turn on the hardness of the external casing of a crocodile resembling the hardness of the external casing of a beetle; and when at last Buffon decides that on the whole a crocodile had better not be classified as an insect: the only reason given is that as a crocodile is so very large an animal it would make 'altogether too terrible an insect.'" May we not venture to suggest that Buffon was here indulging in a sly joke?

We can scarcely agree with Mr. Romanes when he remarks,

concerning the tree-like system of classification, that "no one, even long before Darwin's days, ever dreamed of doubting that this system is in reality what it always has been in name,—a natural system." That strange school founded by MacLeay and Swainson, which at one time considered itself the embodiment of zoological philosophy, would have most emphatically protested against the notion of representing the animal kingdom, or any of its divisions, under the form of a tree.

The second chapter gives the argument from morphology, and shows clearly, though briefly, the principal difficulties which lie in the way of the separate creation, or rather origination, of organic forms. Under this head we meet with a consideration which the author believes is original, and which we do not recollect having found elsewhere. He writes—"We scarcely ever meet with any great departure from the typical form—such as the absence of limbs—without some of the other organs in the body being so far modified as of themselves to indicate, on the supposition of descent with modification, that the animal or plant must have been subject to the modifying influences of a long series of generations. And this combined testimony of a number of organs in the same organism is what the theory of descent would lead us to expect, while the rival theory of design can offer no explanation of the fact that when one organ shows a conspicuous departure from the supposed ideal type, some of the other organs in the same organism should tend to keep it company by doing likewise."

In the third chapter we find, very briefly, the argument from geology, and in the fourth that from geographical distribution. Next follow in succession the evidences from embryology, and finally certain arguments drawn from general considerations.

We are not surprised that our late illustrious leader formed a favourable opinion of the abstract of his doctrines here presented, and we feel confident that, if only widely circulated and fairly read, it will open the eyes of the many who in this country still cling to the old Natural History.

A Rational Materialistic Definition of Insanity and Imbecility, with the Medical Jurisprudence of Legal Criminality, founded upon Physiological, Psychological, and Clinical Observations. By HENRY HOWARD, M.R.C.S. Eng. Montreal: Dawson Brothers.

THIS book, which bears also the title "The Philosophy of Insanity, Crime, and Responsibility," is dedicated, in grateful

remembrance, to the President and Court of Examiners of the Royal College of Surgeons, London. A sort of key-note to the work is found in the Preface, to the effect that the animal mind, as we know it, is the product of organic matter, and that consequently insanity is a physical disease. These convictions have been reached not as the result of reading, but by dint of observations, physiological, psychological, pathological, and clinical. The author distinguishes imbecility, the result of a teratological defect,—or, as it would be popularly called, of monstrosity,—from insanity, the result of pathological defect, that is, of disease whether of an originally properly developed or of an abnormal brain. Imbecility he regards as an intermediate stage between idiocy and intellectuality. He recognises man as the "highest animal type," but pronounces him "the only self-conscious animal"—a somewhat hazardous dictum. We are here struck with a note from the "Chicago Medical Review":—"Dr. J. Kiernan called attention to the fact that the importance of the frontal lobes has been much over-estimated. He claimed that in the occipital lobe were to be found the great association centres of the brain, and, as upon associating power depended man's intelligence, the full development of the occipital lobe was necessary to constitute a well-balanced cerebral system. He cited as corrobatory evidence the fact that the occipital lobes are last to make their appearance in the fœtus. The occipital lobe was markedly deficient in reasoning maniacs."

Dr. Howard, whilst fully admitting degrees or stages in insanity, denies the existence of partial insanity. "A man," he writes, "has but one mind, and that mind, a unit, either is or is not insane. We might as well say that a man had a partial typhoid fever as that he was partially insane." He holds that insanity "is due to a mechanical lesion or chemical change in the sensory nerves and organ of consciousness, which changes render the parts in question anæsthetic: consequently false intelligence, if any, is borne by the sensory nerves to the organ of consciousness, or that organ itself is incapable of receiving intelligence because of its abnormal state. Under any of these circumstances consciousness is deranged or confused to a greater or less degree, intelligence is arrested or dethroned, reason has lost its pilot, reflex action to a great degree takes its place, and the result is insanity."

We are much gratified to find that Dr. Howard recognises the rationality of animals. Says he—"The more we study their actions the more we are convinced there are animals that reason as well as man." We might almost regard this as a test-question to decide whether or no a man is capable of faithful observation.

The following is exceedingly noteworthy:—"I have constantly remarked that at different times there will be a rush into the asylum from some particular locality." This fact the author

suggests may be due to some specific poison present in the atmosphere.

We may now turn to Dr. Howard's general conclusions. These are:—

Firstly, that body and mind are one,—that is, the mind of man, as we know it, is the product of matter, as we know and define matter. Those persons who may feel inclined to denounce the author as a "materialist" will do well to consider certain reservations made on p. 20, where he says—"By this identity of mind and matter I refer simply to the manifestations of mind during this life through its material medium, the body."

Secondly, that insanity is abnormal mind, the consequence of abnormal matter,—therefore a purely physical disease. This conclusion is flatly at variance with, and much more practical than, the view held by not a few jurists and theologians, that insanity is sin.

The ninth conclusion is of an exceedingly serious character. The author writes "that every normal man has under certain circumstances a free will, but every intellectual man, according to my definition of an intellectual man, has a free will by which he controls all his desires. Consequently such a man would not, if he could, be guilty of a crime against society. Before he could be a criminal there must be a physical change in his mental organisation rendering him insane, and consequently irresponsible for his acts." This contention, as we understand it, amounts to a general plea of irresponsibility for all criminals.

In his tenth conclusion he asks "Does the fear of punishment act as a preventative to crime in any person?" The author seems to answer his own question in the negative, and adds—"If ever any means had a fair trial for the prevention of crime it has been punishment, with what effect criminal history can answer."

We think a reply to these views is not far to seek. If the fear of punishment does not prevent crime, how is it that so many offenders carefully and eagerly scrutinise the law in order to find some loophole which may enable them to effect unrighteous ends without peril? Punishment can scarcely be said to have had a fair trial for the prevention of crime. In England it has been stultified by the fundamental error of treating offences against the person more leniently than those against property. Sometimes it has been indiscriminately severe, and sometimes as indiscriminately lenient. It has rarely made a sufficiently broad distinction between the incidental crime into which a man may be led by the pressure of want and the formal war against society for which the burglar and the garrotter deliberately equip themselves. Even as it is we may fairly assert that had there been no punishment crime would be far more prevalent, just as if we had no medication disease would be more rampant. Nature acts on the principle that the species, the race, is of more moment than the

individual. Did we follow her guidance we might stamp out ruffianism as decidedly as genius has been stamped out in Spain. But some of our moralists foster crimes of violence—and in one case disease also—just as distinctly as the receiver of stolen goods cherishes theft.

The author, however, we are glad to perceive and to declare, does not propose to turn dangerous criminals loose upon society as is done by our ticket-of-leave system, under the absurd notion that submission and quiet demeanour during imprisonment prove that the offender is reclaimed.

On the question of free will the author writes:—"No intelligent man can possibly believe that a man's will is always free, when we see the number of persons whose whole lives have been controlled by the will of others, so that they became mere automata. Who if he had a free will would ever allow memory to haunt him, thinking of a thousand things of the past to render him unhappy. Most certainly we cannot always govern our thoughts by our will, and it is equally certain that we cannot by our will govern our desires, words, and deeds. Mere children have no will, yet we in our folly treat them as if they had."

We cannot admit all this: we admit that we cannot completely control our thoughts, but the words and deeds of a normal man are at his command. Most parents find that children manifest a will at a very early age.

This work, containing much which we approve, and, on the other hand, also no little from which we differ, is worth careful reading. An index or table of contents would have increased its value.

The Law of Kosmic Order: an Investigation of the Physical Aspect of Time. By ROBERT BROWN, Jun., F.S.A. London: Longmans and Co.

THE reader may well be disposed to ask how a law of cosmic order can be reached by any analysis of ancient myths and traditions, or by any inquiries into the roots of words. Unless he has a power of reading between the lines, and discovering there something which escapes our ken, he will not find any fully satisfactory answer to his question.

Mr. Brown undertakes to show how the zodiacal signs, "which seem to us so singular, attained their present position by a process so natural as to be almost inevitable; in fact by virtue of that simple law of re-duplication which, combined with the anthropomorphic principle, is the key to the vast majority of mythic fancies." He discards as baseless "theories which connect the Signs of the

Zodiac with deep significance, either religious, philosophical, or scientific," and in so doing he has our hearty sympathies.

In his first section, treating on the importance of ascertaining the mental standpoint of archaic man, Mr. Brown makes a very suggestive remark. He considers that "the gap between past and present"—and the consequent difficulty we men of the nineteenth century experience in putting ourselves in the place of our remotest forefathers—"is not so much occasioned by the multitude of wonderful discoveries and inventions; it arises rather from our familiarity with the ordinary adjuncts of human existence, and the general appearance of the universe in its customary succession of changes; a familiarity which has produced not indeed contempt, but certainly indifference, a state of mind well summed up in the dictum that 'no servant-girl is surprised at the sun'"—an adage evidently of non-British origin. But was man ever surprised at the sun? If so, he must have been in all probability suddenly placed upon the earth, and not gradually evolved from lower organic forms, and must furthermore have been, if not a being of high culture, still not a savage of the lowest type.

The reader thus finds himself led up to one of the burning questions of the day which the author does not indeed discuss, but it appears somewhat plainly what view he embraces. He writes:—"We have thus the three universal concepts of Space, Time, and Number; common to all men, necessities of thought, and hence primary truths." From the working out of the time-concept Mr. Brown considers that man was led to recognise the reign of law and the harmony of the world. Further, this recognition of law and order enables man to express fully his innate ideas of right, justice, law, and the like, but does not furnish him with these ideas."

But the great question is, Are the concepts of time, space, and number, and the idea of justice, not merely common to all men, but peculiar to man as compared with the lower animals? The author's reply may be plainly gathered from the concluding sentence of his treatise:—"So as man became conscious of the splendour and harmony of the external world, did this enable him to express and assist him in comprehending and defining those great ideas and noble feelings which sever him from every other animal." We naturalists who patiently observe the actions of animals come to a very different conclusion. We find among social species, such as rooks and ants, distinct traces of positive law which presuppose the idea of justice. Even among non-social species we recognise the sentiment of property, and we note that, when going beyond their rights, conscience makes cowards of them as it does of men. We likewise see that they recognise a law of cosmic order, an "order of Nature," and on witnessing any apparent departure therefrom they display a superstitious dread akin to that shown by savages at some supposed

portent or miracle. In like manner the concepts of number, time, and space are not wanting among brutes, as any candid inquirer may easily find to his satisfaction.

We are compelled further to differ from the author when he says "the higher instincts of our nature are independent of the observation of natural phenomena, or otherwise they would be absent in one born blind." Surely no one contends that the instincts of a species originate *de novo* in every individual of such species! Are they not the product of successive generations, handed down, like structural peculiarities, from parent to offspring?

A Manual of the Geology of India. Part III.—Economical Geology. By V. Ball, M.A., F.G.S. Calcutta: Office of the Geological Survey of India. London: Trübner and Co.

This volume will clear away two opposite errors. It will, on the one hand, dispel some of the sensational visions of untold wealth to be gained from Indian mines, but it will also overturn the contemptuous estimates of the mineral deposits of the country in which some writers have indulged. It is true that English lead, copper, and iron are underselling the indigenous products; but, on the other hand, both Government and private companies have worked coal- and salt-mines and stone-quarries with very great profit. In the course of the next few years "the capabilities of India not only as a gold-producing country, but also in reference to other metals," will be fairly tested. The task of the officials of the Geological Survey has not been easy. The area to be worked over is immense in comparison with the time allowed and the number of investigators; and, in addition, the natives are not merely disinclined to furnish information as to the mineral wealth of the several districts, bat even take steps to prevent the deposits from being discovered. The Survey, however, under all difficulties, has proved the possibility of certain minerals occurring in given tracts, and has conclusively shown the futility of searching for them elsewhere.

The first chapter treats of the diamond, graphite, and amber. Golconda (Kala-kandar), it appears, never produced diamonds, but was merely the mart where they were bought and sold. The three chief localities in which diamonds have been found, and may be sought for with some prospect of success, are on and near the Godavari, between this river and the Mahanadi, and in Bundelkhand. They occur in the lowest beds ot the Vindhyan formation. It appears probable that the original matrix of the

Cape diamonds belongs to a horizon directly comparable with that which includes the Indian diamonds.

The author considers it probable that diamond has been formed by crystallisation from a liquid hydrocarbon, the carbon having, according to Liebig's views, been purified by the gradual elimination of CH_4. The experiments of Sir D. Brewster render it at least probable that the diamond must have been at one time in a soft state. The author thinks that the Koh-i-nur is the basal portion of the Great Mogul diamond. It has been suggested by native authorities that the original name of this stone was the Kollur diamond. "Such changes, in which, while the sound is more or less retained, a meaning is acquired, are not by any means rare in Oriental languages."

Graphite occurs in various parts of India, and samples have been brought to England. Whether they will ever become of commercial importance, like that found in Ceylon, is open to doubt. In some localities a workable thickness cannot be obtained, whilst in others the mineral is contaminated with silica and iron. The former impurity, when occurring, renders graphite unfit for use in pencils and as a lubricant, whilst iron spoils it for the manufacture of crucibles.

The only source of amber in India appears to be in Burmese territory.

The next chapter treats of coal, peat, and petroleum. The rocks in Peninsular India, which probably correspond to the true carboniferous rocks of Europe, bear no coal: the useful coal of the Peninsula is of Permio-triassic age. Beyond the Peninsula coal is found in more recent deposits. The coal-bearing areas of India are estimated by Mr. Hughes at 35,000 square miles, though it must not be supposed that workable coal exists everywhere in this region. Much injury has been occasioned by the carelessness and ignorance of persons who have undertaken to work the deposits. One of the plates represents a "gin," in which the motive power is supplied by — women!

A curious fact is here mentioned, *i.e.*, that the operations of the coal-ring in 1872, which produced such disastrous results in England, did not perceptibly affect the price of fuel at Calcutta.

True peat only occurs in tropical regions in upland districts where the climate is substantially temperate. It is met with in the Nilgiris, and if rationally utilised might lessen that destruction of the forests which has wrought such mischief in many tropical and sub-tropical regions.

Petroleum is entirely absent in Peninsular India, but it occurs in Pegu, Arracan, Assam, &c. In the Punjab wells exist which a specialist, Mr. Lyman, estimates might produce 100 gallons of oil daily for eight years, after which the supply would probably fail. It is noted that in India, just as in Pennsylvania, petroleum and brine springs occur simultaneously,—a fact which seems to indicate that the formation of petroleum is in some unknown

manner connected with the presence of salt. The wells in British Burma are of much more importance, a well in Eastern Baronga having at one time yielded 1000 gallons a day.

The deposits of sulphur in India are of little importance, and are situate chiefly in localities difficult of access. Arsenic and bismuth are also found, but sparingly. Concerning the latter metal we find the curious remark that it enters into the composition of mordants for calico-printing. We are not aware that it has ever been used for this purpose on a practical scale.

An enormous lode containing antimony ores (stibnite, cervantite, and kermesite) has been discovered at Shigri, in the Punjab. Platinum occurs in a number of localities on the small scale.

Tradition points to the existence of mercury in the Andaman Islands, but no proof has been obtained.

That the ruling dynasties of Southern India at one time possessed vast quantities of gold is beyond doubt. Whether the deposits have become exhausted, or whether the precious metal may still be obtained in remunerative quantities, will probably soon be decided by the operations of mining companies in the Wynaad and elsewhere. A number of the natives in the auriferous districts occupy themselves with gold-washing, but their earnings are described as generally but trifling.

Tin is met with in remunerative quantities in the Tenasserim district.

Cobalt occurs in Nepal and Burma. It is used by the native jewellers in colouring enamels and bangles blue, and in producing a fine rose-colour on gold by a process unknown in Europe, and preserved as a secret in certain families.

In like manner the author works over all minerals useful in the arts and manufactures, pointing out where they have been discovered, or actually raised on a practical scale, and discussing the probability of their being made remunerative. The results of this comprehensive survey must be pronounced, upon the whole, somewhat disappointing to those interested in the prosperity of India. Still it must be remembered that the Geological Survey of India has been able to give as yet little beyond a broad general sketch. Even in Britain, where explorers are a hundredfold more numerous, and where they meet with so much greater facilities, valuable deposits of minerals are still from time to time discovered. It is therefore far from unlikely that such will be the case also in India.

Geological and Natural-History Survey of Canada. Report of Progress for 1879-80. By ALFRED R. C. SELWYN, LL.D., F.R.S., Director. Montreal: Dawson Bros.

THIS volume opens with a general report by Mr. Selwyn on the work of the season. We learn that the explorations and surveys undertaken during 1880 embrace the North-western territories with the Souris River Coal-fields, Manitoba, the Quebec district on both sides the St. Lawrence, New Brunswick and Nova Scotia, and the Magdalen Islands. Several collections of fossils have been examined, including a small series of fluviatile mollusks from the Lignite Tertiary of the Souris River, Manitoba; about ninety fossils from the Palæozoic and Devonian of the Pine, Battle, Burnt, and Elk Rivers, in British Columbia; a series of Cretaceous fossils from the same region; Lower Silurian and Devonian fossils from the Red River, Manitoba; and fishes from the Devonian of Scaumenac. The chemical laboratory has been engaged in analysing lignites, iron, copper, and manganese ores, specimens of graphitic rocks, minerals containing the precious metals, determinations of nickel and cobalt in pyrholite from different localities, &c.

The Director complains, not without reason, that the sum of 50,000 dollars annually voted by the Dominion Parliament is very insufficient to carry on explorations extending from the Atlantic to the Pacific, to support a museum, laboratory, and library, and to publish the results obtained in two languages.

Of particular interest is the special report on Hudson's Bay and the adjoining country, by Dr. Bell. At York Factory, on the shore of this Bay, which has been called the Mediterranean of North America, the first rain of the year falls about the end of April, the last snow occurs towards the end of May, whilst the first snow-fall of the next winter varies from the 8th to the 28th of December. During the summer the rainfall is at times exceedingly copious, 4·3, 6·5, and 7·6 inches of rain being recorded each in a single day. The short summer, however, is generally fine, and the soil productive, so that the country is by no means unfit for agriculture. Minerals, however, must constitute the greatest of the resources of the surrounding country. The author reports inexhaustible supplies of good manganiferous iron ore on the islands near Eastmain coast, galena round Richmond Gulf, rich ironstone on the Mattagami, as well as lignite, petroleum-bearing limestones, sulphur ores, soapstone, and graphite. Dr. Bell considers Hudson's Bay and its region important, not merely to Canada, but to the entire Empire, because the future highway from Britain to the great North-west of the Dominion may pass through it. The Nelson Valley Railway Company have surveyed the country from Churchill Harbour to

Lake Winnipeg, and find the country easy and inexpensive. York Factory is nearer to Liverpool than is New York. The proposed line will afford a route for the introduction of emigrants which will entirely avoid the United States and the populous parts of Canada, and, on the other hand, will afford a convenient outlet for the North-west territories, which "embrace hundreds of millions of acres of fine lands destined to become the greatest wheat-field in the world."

A very interesting portion of the work of the Survey has been the mapping out of thirty of the principal forest trees of the Dominion, showing their northern limits. The map constructed is of no small importance, both botanically and from a climatological point of view. The conclusion is drawn that the present divisions of prairie and woodland are of very ancient date, and are not due to forest fires.

As appendices to this Report we have a list of plants collected in the Hudson's Bay country, running to the number of 261. The majority of these belong to the Ontario flora. There is a list of Coleoptera, collected in 1880 in Manitoba, and between Lake Winnipeg and Hudson's Bay. The forms, as might be expected, are boreal. The Lamellicornes are few and small, the Buprestidæ and Elateridæ scanty, and the Longicornes less developed than might have been expected in a richly-wooded country.

The report on the Magdalen Islands, a small group situate in the Gulf of St. Lawrence, is accompanied by a local flora, from which it would seem that the climate is scarcely warm enough for the cultivation of wheat.

The flora of Nova Scotia is characterised by ferns, which, for North America, are numerous both in species and individuals. It is to be noted that many species are common to this region and to Britain, such as *Polypodium vulgare*, *Pteris aquilina*, *Asplenium Trichomanes*, *A. Filix-fœmina*, *Phegopteris Dryopteris*, *A. Filix-mas*, *A. lonchitis*, *Osmunda regalis*, &c.

It is to be hoped that the Dominion Government will not allow Mr. Selwyn's hands to be tied from want of the necessary funds.

Geology of Wisconsin. Survey of 1873—79. Vol. III. Published under the Direction of the Chief Geologist, by the Commissioners of Public Printing.

Not a few of the States of the American Union are displaying no less zeal in the geological examination of their respective districts than is the Federal Government in its grand survey of

the so-called "territories." The diligence of Wisconsin in this important task will be more fully appreciated if we remark that the volume before us—the third of the "final report" of its survey—extends to 763 large and very closely-printed pages, abundantly illustrated with maps, plans, sections, views of characteristic scenery, &c.

The Report comprises, in its main divisions, the General Geology of the Lake Superior Region, by R. D. Irving; the Lithology of the Keweenawan or Cupriferous System, by Raphael Pumpelly; the Geology of the Eastern Lake Superior District, by R. D. Irving; the Huronian Series west of Penokee Gap, by C. E. Wright; the Geology of the Western Lake Superior District, by E. T. Sweet; the Upper St. Croix District, by the late Moses Strong; the Menominee Region, by T. B. Brooks; and the Economic Resources of the Menominee Iron Region.

The entire extent of Wisconsin presents much that is highly interesting to the geologist. The series of strata measure about 100,000 feet in thickness, and include four great systems,—the Laurentian, the Huronian, the Keweenawan, and the Lower Silurian, each uncomformable to its predecessors.

Concerning existing theories on the origin and age of these formations, and of the structure of the trough of Lake Superior, the author regards most of them as hasty. The Keweenawan is characterised as the "copper-bearing" system. Copper, indeed, constantly accompanies these rocks throughout their entire extent in Michigan and Wisconsin, and is associated with silver, though in small quantities. The Menominee region, on the other hand, contains abundance of iron in the Huronian system. It appears that an earlier survey of this region, executed under the orders of the Federal Government, is not merely "entirely inaccurate, but absolutely fraudulent and false." A certain "Spread Eagle Lake" was not only never surveyed, but apparently was seen only in part by the Deputy Surveyor, who swore to having traversed and mapped it according to his contract.

We find some interesting observations on the climatology of the Lake Superior country. The mean annual temperature at the lake shore is 38° F.—certainly low for the latitude. The spring months show a mean temperature of 34°, summer 62°, autumn 40°, and winter 15°. Winter sets in about the end of October. It is mentioned that in 1877, though an early season, the snow was all gone by the 1st of May, though "ice was found in the swamps two or three weeks later." Strawberries ripen on the south slope about the 1st of August, and on the north slope from the middle to the end of August. In the main body of Lake Superior the water, which is of exceptional purity, never exceeds the temperature of 46° F.

Concerning the fauna and flora of the region we find but little

information. Beasts of prey are rare. There are very few birds; indeed it is said that a person may travel for a day in the woods, in spring or autumn, without meeting half a dozen. As may be inferred from the geological character of the region, there is but a very scanty harvest for the palæontologist. In the list of trees we find the name "tamarac" given to *Larix americana*. But the "hemlock" (*Abies canadensis*) is said to have a bark very rich in tannin; and, unless we are misinformed, the substance met with in commerce under the name "tamarack," and used to some extent by tanners and dyers, is obtained from the latter tree.

Memoirs of the Geological Survey of India. Vol. XVI., Part 3. Calcutta: Geological Survey Office. London: Trübner and Co.

THIS part gives an account of the Upper Gondwanas, and other formations of the coast region of the Godavari district. There is a particular description, with an illustration of the gorge of the great Godavari river, in which the water is said, in flood-time, to rise 100 feet above its ordinary level.

We find the curious remark, in a note, that the Kaurkonda Hill is "one of the few spots in this part of the Presidency still frequented by *bison*." Just as the Americans call the true bison of their country "buffalo," it appears that certain Anglo-Indians invert the error.

One part of this district is reported to have yielded diamonds, but the old workings are quite abandoned. Iron ore is abundant, but smelting is limited by the scanty supply of fuel.

Vol. XVIII., Parts 1, 2, and 3.

THE first of these parts deals with the geology of the section between the Bolan Pass and Girishk, in Southern Afghanistan; the second comprises the geology of the districts of Mánbhúm and Singhbúm; and the third gives the geology of the Pránhita-Godávari Valley. It appears that till lately gold was obtained in considerable quantities near the city of Kandahar, where it occurs in quartz veins traversing the zone of contact between the hippuritic limestone and the trap outbursts. Some of the nuggets obtained were of the size of a man's fist. A poor ore of copper is found in the Kojak-Amran Range, and a richer ore is now being worked in the Shah Makhsud Range. Lead occurs in many localities in Southern Afghanistan. Argentiferous galena and native silver are said to occur in the Hazarah country, at Siah-Sang and at Herat. Petroleum springs exist in the Marri

Hills, but have not been examined. Coal is found in thin seams near Sharigh, but in the author's opinion would not repay working. In Mánbhúm and Singhbúm gold-washing is carried on by the natives, and their earnings, as compared with the price of field labour, are considered good. The manganiferous iron ores of Chárbásá will be of value for the manufacture of spiegeleisen if iron smelting is taken up on the large scale in the Rániganj coal-fields.

The Godávari Valley contains deposits of coal and iron, which may become of importance if the Godávari navigation is completed. The gold-washings of the district are inconsiderable.

John Bunyan and the Gipsies. By JAMES SIMSON. New York: James Miller. Edinburgh: Maclachlan and Stewart. London: Baillière, Tindall, and Co.

WE have had pleasure on a former occasion in noticing Mr. Simson's estimate of Charles Waterton; but with John Bunyan the "Journal of Science" does not and cannot concern itself, and consequently any question as to his nationality falls entirely outside our competence.

Journal of the Proceedings of the Royal Society of New South Wales, 1881. Edited by A. LIVERSIDGE, Professor of Chemistry and Mineralogy in the University of Sydney. Sydney: Thomas Richards.

THIS number of the "Journal of the Royal Society of New South Wales" is by no means so rich in scientific investigation as might be hoped from a body placed where there is so much novel matter to be observed. For this shortcoming the indefatigable secretaries, Prof. Liversidge and Dr. Leibius, cannot be held answerable. We know from private sources that they do their utmost for the efficiency of the Society; but if the bulk of the members and the outside public cannot or will not "work," where are papers and memoirs to be obtained?

We regret to learn that the financial position and prospects are not of the brightest. Were it not for a Government subsidy, of precarious duration, since dependent upon an annual vote of the Colonial Legislature, the efficiency of the Society would be seriously compromised.

We note with mingled feelings the proposal for the establishment of a biological station in the neighbourhood of Sydney. We are certain that such an institution could not fail to yield results of the highest interest and value. The unworked field in every department of biology is in that region immense and fruitful. But we cannot help feeling a certain share of humiliation that this praiseworthy undertaking should have been left to be set about by a foreigner—the celebrated Russian traveller, Baron Maclay—and that his zeal should hitherto have met with but a cool response. The Government has granted an eligible site at Watson's Bay, and has engaged to double the subscriptions up to £300, but the necessary £300 has not yet been made up. A small beginning has been made in a cottage, affording five work-rooms. It is not intended, as in Dr. Dohrn's far-famed station at Naples, to make a charge for each work-table or room, but it is proposed that every naturalist making use of the building should pay, say, 5s., weekly towards current expenses. Baron Maclay remarks that the "time has arrived when mere collecting should be abandoned, and when the great aim of scientific travellers should be observation and investigation, exercised immediately and upon the spot." He considers that "next after the tropics the widest field offered to the investigator of nature, and consequently the most suitable region for the establishment of zoological stations, is Australia." May we not hope that some among that numerous class of our readers who are specially interested in biological research will see their way to aid in the establishment of the Watson's Bay Station?

The papers in the present number of the Society's "Proceedings" are "The Climate of Mackay," a port on the east coast of Queensland, by H. L. Roth, F.M.S.; "Notes of a Journey on the Darling," by Mr. W. E. Abbott, a record of topographical and geological observations, with important suggestions on the greatest practical problem of Australia,—the obtaining an ample and constant supply of water. The Rev. P. McPherson contributes a paper on the "Astronomy of the Australian Aborigines." Mr. H. C. Russell writes on the "Spectrum and Appearance of the Recent Comet." The same author communicates memoirs on "New Double Stars and Measures," and on the "Transit of Mercury of November, 1881." Mr. W. A. Dixon, F.C.S., gives some interesting particulars on the "Inorganic Constituents of Epiphytic Ferns," the result of his inquiries being that the fronds contain a much larger proportion of mineral matter than would be looked for in plants growing not in direct contact with the soil. Baron von Mueller, F.R.S., contributes a "Census of the Genera of Plants Indigenous to Australia,"—a document valuable for reference, but of course unsuitable for quotation or discussion.

"Notes on Wool," by P. N. Trebeck, contains some interesting

matter. It appears that the spear grass of the coast country, near Rockhampton, pierces through the skin and flesh and kills sheep in a few days.

Victorian Year-Book for 1880-81. By H. H. HAYTER, Government Statist. Melbourne: Ferres. London: Robertson.

WE find here an extensive assortment of useful information. The general salubrity of the Australian colonies is still maintained, the general death-rate for the whole group including Tasmania and New Zealand, being, on the years 1873 to 1879 inclusive, only 15·44 per thousand, which is more favourable than that of any European country from which accurate returns are obtainable. The most fatal disease, as in England, is phthisis, and next to it diarrhœa. Cancer ranks *eight* in the scale.

As regards the criminal statistics, drunkenness figures with sad prominence. Out of a total of 23,983 persons arrested in 1880, no fewer than 10,056 were for drunkenness. As regards the birth-place of the offenders, it appears that 7359 criminals were Irish, 6188 English or Welsh, persons born in Victoria 5688, and Scotch 2008.

A very painful fact is that the phylloxera succeeded in establishing itself in the Geelong district as far back as 1875, and though it has not spread into any other part of Australia, all the measures tried for its extirpation have proved fruitless.

It appears that the inhabitants of Australia consume a larger proportion of animal food than the population of the home kingdoms. This circumstance, as may be judged from the death-rate, does not appear to have an injurious effect on their health or longevity,—a fact which dietetic reformers would do well to consider.

CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

THE CLIMATE OF WEST AFRICA.

To the Editor of the Journal of Science.

SIR,—In the Notes of your issue for August is a note as follows (p. 500):—"On the West coast of Africa teetotallers die first, hard-drinking men second, whilst the temperate live longest." I have had some considerable experience of living on the West coast of Africa. Take the "temperate" in the largest sense the remark is true. A man may be temperate in the use of alcoholic drinks, but intemperate in eating, which I think is more fatal than the use of liquors and wine: these latter in a great degree counteract the effect of the miasmic exhalations. Gorging the system with solid substances makes it more apt for the introduction of fever germs, and is without the corrective effects of alcohol. The usual course of meals adopted was as follows:—At 6 o'clock a.m. coffee and bread or biscuit: at 11 a.m. a dinner of several dishes, omitting soup and substituting tea or coffee (wines of course). Dinner at 5 or 6 p.m. The breakfast repeated on a large scale, with soups. At both these meals the participants indulge freely (as a general rule).

My observations showed that excessive eating was more fatal than excessive drinking. As a rule the climate was most fatal to new comers who were Germans. The mode of dress—but that is now corrected—was flannel next the skin, long cloth shirt, and a vest and outer coat of a thick close-thread texture. The consequence was that persons so clothed were always hot and uncomfortable, a clammy moisture continuously clinging to the skin, owing to the arrest of the exhalations by the outer coat. The reform was as follows.—Long cloth shirt next the skin, and outer garments of woollen substances. The exhalations of the body passing through the shirt were quickly passed through the wool, and left the skin moist but not clammy.

There came under my observations three persons who did not perspire; they all died within two months of their arrival. There is also a curious physiological fact which I observed, but have

never seen it remarked on, *viz.*, that the skin of the negroes when in health—even when streams of perspiration were pouring down them—was to the touch as cold as marble; heat on the skin was to them always an indication of fever.

In the year of my advent on the coast there were twenty-one new comers—five Englishmen and sixteen (principally) Germans. Out of the twenty-one fourteen died, four Englishmen (one of whom did not perspire); the other ten were Germans. Those who died were intemperate, mostly in eating. As a rule excess in drinking is not exhibited, new comers being warned against it. Brandy and water drinkers fared worse than wine drinkers. Beer, in my opinion, is almost poison.

I may remark that I had a very severe attack of malarial fever contracted in the interior, and had to ride on horseback, whilst under its influence, nearly 30 miles. But for this, and its influence in the nature of *black* boils, which I suppose to be an effort of Nature to purge the blood of the poison, and a severe inflammation of the eyes, during my residence on the coast of between five and six years, I had not even a finger ache.

The bad name given to the West coast of Africa arises more from the excesses of its exotic denizens than from the real effects of the climate. After the acclimative fever—which all have more or less severely—the health of the old denizens is good; a little fever sometimes, and that is all. I do not think that a more pleasant (and, I may say, healthy) climate can be found than the West coast (Gambia I am speaking of) of Africa from the end of October to the commencement of June. From June to October is bad enough. August is generally the most fatal month to new arrivals.—I am, &c.,

S. Billing.

SIZE OF HEADS.

To the Editor of the Journal of Science.

Sir,—Your note on the decrease of size of hats between 1855 and 1880 does not seem to take into account the present fashion of cropping the hair: this alone would account for the decrease of hats without decrease of heads. As brims now give more shelter than those of 1855, the hats are now probably required to cover less of the head. Till these matters are taken into account smaller hats will not prove smaller heads.

There is another human variation to which attention might well be drawn, *viz.*, the greater size and strength of girls. I have no measurements, but observation convinces me that our daughters, especially of the middle and upper classes, are much

taller than their mothers. Better exercise, better dress, and perhaps better food and air, might lead us to expect an increase in the height of our tennis-playing generation of girls, but I fancy it is more than would be expected—perhaps quite half an inch. Is this the first stage in the development of the late Lord Lytton's "Coming Race"?—I am, &c.,

HUGH BROWNE.

Nottingham, September 20, 1882.

INTELLIGENCE IN A HORSE.

To the Editor of the Journal of Science.

SIR,—The following incident may be interesting to some of your readers. It is well known that horses in some parts of South Africa are much annoyed by a kind of tick, which sucks their blood till it swells out to the size of a large pea. A charger named Joe, belonging to the Colonial cavalry stationed at Maseru during the Basuto War, if thus attacked whilst pasturing would canter to the fort, seek out his rider, and express by signs what was the matter. The trooper would seek out the tick, crush it, and throw it on the ground. The horse has then, on more than one occasion, examined the remains of its enemy, and given them a blow with his fore-hoof, as if to make "assurance doubly sure."—I am, &c.,

E. A. S.

OBJECTS SEEN THROUGH BLUE GLASS.

To the Editor of the Journal of Science.

SIR,—The glass used by your correspondent ("Journal of Science," September, 1882, p. 562) was in all probability the ordinary blue glass coloured with cobalt: this if examined with the spectroscope will be found, according to its depth of tint, to transmit more or less red light, which would account for some of the tints observed. The effect is easily seen in the lights of some tramcars which are coloured blue; in addition to the blue tint of the glass, a strong red colour may be observed about the light. I will examine the glass used if your correspondent wishes it.—I am, &c.,

W. T. SUFFOLK.

"FELLOW OR MEMBER?"

To the Editor of the Journal of Science.

SIR,—Can you inform me what entitles a Society to dub its constituents "Fellows" instead of Members? A legal friend tells me that only bodies incorporated under a Royal charter are duly entitled to make use of the former term; but there is at least one instance where a Society which has no such charter, but is merely enrolled under the "Companies' Act," has appropriated the more assuming name. Hence it would seem that if there is any positive law on the subject it is never enforced.—I am, &c.,

B. S. W.

A TALKING SWAN.

To the Editor of the Journal of Science.

SIR,—I have heard, on what I believe to be unimpeachable authority, of a swan which had learnt to utter a few words. The bird in question, an old female, lived in solitude on a large reservoir belonging to a woollen-mill near Huddersfield. Its vocabulary, picked up from the factory girls, was very limited, and of too "unparliamentary" a character to be quoted in the "Journal of Science." I never before heard of a bird belonging to this order acquiring human language.—I am, &c.,

VIATOR.

THE EFFECT OF TEMPERATURE ON FISH,

To the Editor of the Journal of Science.

SIR,—Having frequently been informed that carp could live at excessively high temperatures in the pools formed by the water which has been used for the slacking of slag in the black country, and also in the warm springs of Japan, I have made experiments to ascertain the limits of temperature which Prussian carp (*Cyprinus Gibellio*) can endure, and the results of these experiments clearly show that the truth is strikingly different from that which is generally supposed.

The greatest warmth that Prussian carp can stand is 96° F., or 2 degrees below the temperature of the human body, and a considerably greater number of degrees below the temperature of a warm bath. The greatest cold that this species can sustain is 2 degrees above the freezing-point, thus limiting their range of temperature to 62 degrees.

My experiments, however, have as yet been confined to Prussian carp.—I am, &c.,

A. Anthony Nesbit, F.C.S.

Laboratory, 38, Gracechurch Street.

AN ANTI-DARWINIAN ARGUMENT REFUTED.

To the Editor of the Journal of Science.

Sir,—A standing argument against the formation of new species by the preservation and accumulation of accidental divergencies from the original stock has been the contention that, if an individual possessed any structural peculiarity, such feature must soon disappear by successive matching with individuals of the normal structure. The following instance, which I copy from "Land and Water," proves that such disappearance is not necessarily the case:—

"About twelve months ago Mr. Peter Low, flesher, High Street, Montrose, bought a ram with four horns from a lady in town, which she had gained at a raffle at a church bazaar in Brechin. Mr. Low put the ram into a park with a black-faced Highland ewe, and the result was that the ewe gave birth to twins, male and female, on July 9th last, the ram having five and the ewe four horns, all well developed. The lambs are both strong and healthy.—N."

We see here that the ram, though mated with a normal ewe, transmitted his abnormal feature to his posterity not merely unimpaired, but in the one case even intensified.—I am, &c.,

Observer.

NOTES.

LITERARY NOTICE.—Mr. A. H. Swinton, author of "Insect Variety," is preparing for publication a Table of Sun-Spots and Earthquake Phenomena, by means of which many public calamities may be safely predicted. Any public institution or private individual desirous to assist in the publication of these useful observations, extending over the Christian Era, will kindly intimate the amount of their subscription, for which copies will be sent. The money will be returned unless the expense of publication is fully covered. Address, "Binfield House, Waterden Road, Guildford."

According to the daily papers at the Congress of Librarians recently held at Cambridge, Mr. E. B. Nicholson, the Bodleian Librarian, proposed a resolution in favour of the opening of libraries, museums, and art-galleries on Sundays, but it was not discussed, the "previous question" being carried by acclamation. Some of our contemporaries seem to regard this action as the outcome of a blameworthy selfishness. We rarely, however, find men of any class eager for an increase of duties without any corresponding increase of remuneration. Those who wish for the Sunday opening of museums, &c., should set their face, above all things, against the introduction of refreshment-rooms in such establishments. This modern blunder—we believe of South Kensingtonian origin—enlists a numerous, earnest, and well-organised body against the proposed Sunday opening.

We learn that a joint Annual Meeting of the two "Anti-Vivisection" Societies took place at the end of August. Besides the Rev. Mr. Grove and the inevitable Mr. Jesse there were present three men, four women, a small girl, and four reporters!

M. D. van Monckhoven ("Comptes Rendus") says the expansion of the central rays of hydrogen is absolutely independent of temperature, and is simply due to pressure.

A single shock of earthquake was felt at Couchey, in the Côte d'Or, early in the morning of August 14th. The barometer remained stationary, and domestic animals showed no disquietude either before or after the occurrence.

Prof. Wiesner, of Vienna, has continued the researches of Darwin on the power of movement in plants, and has brought to light many interesting facts.

According to "Ciel et Terre" the birds of passage which return early in the season, up to April 13th were, almost without

exception, in advance of their ordinary times. From April 14th onwards they were almost as regularly too late.

The "Bookseller" places Miss Hunt's "Private Instructions in Organic Magnetism" under the heading "Charlatanism."

The "Popular Science Monthly" rightly says—"Two unregulated and overwhelming passions in this country stifle the growth of Science,—the intense and absorbing passion for wealth, and the universal infatuation for politics. These are great national diseases, not peculiar to America, but malignant in America, and the state of mind they engender makes the systematic cultivation of scientific thought next to impossible.

Dr. F. Oswald, in an article on longevity ("Popular Science Monthly") states that "London holds about the medium in death-rate between New York and St. Petersburg." All returns we can find assign a much higher mortality to New York than to London. The figures for three weeks taken at random are—New York, 34, 31, 30, as against London, for the same weeks, 21, 18, 17.

The "Economical Section" of the British Association, instead of being amputated, has been this year as active as ever, and appears, to us at least, to approach more and more to the character of a political debating club.

According to the Report of the Chief Inspector of Mines, in Victoria, a very large proportion of the accidents are due to the recklessness of the men.

The new equatorial of the Halsted Observatory, at Princeton, in New Jersey, now complete, is the fourth in size in the world. Its object-glass is 23 inches in diameter, and has a focal distance of 30 feet.

M. Spring (Belgian Academy of Sciences) concludes that the seat of the electricity of storms is not, as generally admitted, in the moist region of the atmosphere, but in the cold and dry superstratum.

M. Zenger ("Ciel et Terre") maintains that the hurricanes of the West Indies and the typhoons of the Chinese Sea have a period of twelve days, equal to that of the rotation of the sun.

Dr. Mackintosh has been appointed to the Professorship of Natural History in the University of St. Andrews *vice* Prof. H. Alleyne Nicholson.

According to M. L. Crié, Pierre Belon, of Mans, in a work published as early as 1558, originated the so-called binary nomenclature for animals and plants, the credit of which is commonly given to Linnæus. Belon also devised the classification of birds which has been substantially adopted by Linnæus and Cuvier.

At the late Congress of German anthropologists, at Frankfort, Prof. Virchow eulogised Darwin's work on Anthropology.

A disease among sugar-beets is spreading on the Continent. So perhaps, in spite of bounties, the sugar-cane may again become sole master of the situation.

Dr. C. W. Siemens, in his Presidential Address at the recent meeting of the British Association, mentions the Linnean among the "special Societies which have sprung into existence since the foundation of the British Association." As the Linnean Society was founded in 1788, and received its charter of incorporation in 1802, there is here a mistake either on the part of the speaker or of the reporter.

The woodpeckers in Norway bore into telegraph-posts, being misled by the humming sound into the belief that there are insects in the wood. The bears sometimes scratch away the heaps of stones put to support the pole, thinking that the noise proceeds from a nest of bees.

We find that the "Revue Coleopterologique" has ceased to appear.

Mr. Moore, in his "Lepidoptera of Ceylon," mentions that the caterpillar of the oleander hawk (*Daphnis Nerii*) feeds upon the cinchona as well as the oleander. This is a most curious fact if we consider how recently the cinchona has been introduced into Ceylon, and that the two trees differ most widely from a chemical point of view. *D. Hypothous*, a nearly allied species, feed also upon the cinchona.

The total number of known North American ferns is 156.

We learn that the Rev. W. D. Cowan is returning to Madagascar with the object of exploring the entomology of the southern portion of the island.

Mr. F. L. Harvey ("American Naturalist") witnessed a female of the American woodcock (*Phitohela minor*) carrying her young one away from danger. She held the nestling between her legs, supporting it with her feet.

The Museum of Iowa College was among the buildings destroyed by the tornado of June 17th.

At the meeting of the Entomological Society, September 6th, Mr. McLachlan, F.R.S., exhibited a specimen of the "induvial" limestone from the Eccene formations of Auvergne, composed of the fossilised cases of caddis-worms, to each of which were attached a multitude of minute univalve shells. There are about ten or twelve cases to the cubic inch, and as the deposit, which underlies the lava, is about 6 feet in thickness, the number of specimens must be immense. No traces of the larvæ themselves remained.

Mr. J. Jenner Weir gave a communication showing that fishes as well as birds refuse to devour bright-coloured and hairy caterpillars.

Miss Ormerod described observations proving that the "rape-cake" from India (mustard-cake) is destructive to wireworms.

The Midland Union of Natural-History Societies, founded in 1877, includes now no fewer than twenty-five local societies. It holds annual meetings during the summer, at which an account is given of work done, whilst the following day is devoted to botanical, geological, entomological, &c., excursions. Two local floras, respectively of Warwickshire and Leicestershire, are being prepared under its auspices. Geological researches are also being conducted. Many Coleoptera hitherto new to the Midlands have been discovered, and one or two species probably new to Science. The organ of the Union, the "Midland Naturalist," contains a number of very interesting papers, and puts on record many scientific observations which might otherwise pass unnoticed. For such a body very much work remains to do. The local distribution of British birds, insects, plants, &c., is by no means mapped out. Indeed in insects all the orders save the Lepidoptera, and to a smaller extent the Coleoptera, have been in this respect neglected.

The mysterious force named by the Hindûs "Akasa," or "Akassa," is said ("Psychological Review") to be identical with the Od of the late Baron Reichenbach.

The University of Würzburg, by occasion of its tercentenary jubilee, conferred the degree of "Doctor Philosophiæ Honorarius" upon Sir J. Lubbock and Prof. Huxley.

M. Certes ("Comptes Rendus") has observed and described an intestinal parasite in oysters from all localities, to which he has given the name *Trypanosoma Balbiani*. It approaches closely to *T. sanguinis* of Gruby, recently described by Prof. Ray Lankester under the name of *Undilina ramarum*.

Following upon the celebrated Huddersfield case of lead-poisoning through the public water-supply comes a somewhat similar affair at Keighley, which terminated fatally. A medical witness stated before the Coroner's jury that he had reported sixty-four cases of lead-poisoning to the municipal authorities about a year ago. It will be very serious if the use of pure waters has to be discontinued on account of their action on lead service-pipes. The circumstances under which water corrodes lead, and the possible means of prevention, require to be more closely investigated.

M. de Pietra-Santa ("Comptes Rendus") concludes that at Paris typhoid fever is most severe in the months of April and

November; that its distribution in the different arrondissements is unequal; that the number of deaths from this fever stand in no direct and constant relation with the population of the districts, their extent, the state of crowding, or the general mortality. It is impossible to ascribe to this disease a single cause, the "fœcal origin" of English sanitarians.

The "Darwin Prize" of the Midland Union of Natural-History Societies has been this year awarded to Prof. A. M. Marshall, D.Sc., M.D, for zoology.

Mr. F. B. Campbell, in a memoir read before the Linnean Society, shows reason for believing that parthenogenesis occurs among house-spiders,—a perfectly novel phenomenon, if established.

Herr E. Döll ("Verhandl. Kais. Kon. Geolog. Reichsanstalt") points out the existence of a zone of country in Hungary particularly affected by meteorites. Of the eight known cases recorded in the twenty-five years up to 1877, six fell in this region, and subsequently two more. In 1877 Dr. Lawrence Smith traced a local grouping of the North American meteorites.

A correspondent of the "Medical Press and Circular" speaks of the odour of the heliotrope as an efficient narcotic.

MM. Bokorny and Loew, of Munich, have forwarded to the Academy of Sciences a series of microscopic preparations demonstrating the differences between living and dead protoplasm.

According to "Ciel et Terre" four new planetoids have been recently discovered. Nos. 226, 228, and 229 were first seen at Vienna, by M. Palisa, on the 5th, 19th, and 22nd of August; whilst No. 227 was discovered on August 12th, by M. Henry, of the Observatory of Paris.

M. J. Vincent ("Ciel et Terre") records that in Belgium the average temperature of the month of August was lower than the average by 1·5° C. (=2·7° F.). The rainy days were twenty-four as against a mean of seventeen. The cloudiness has been 7·9 in place of the average of 6·2. Not a single day has been completely cloudless, and for two days the sky was entirely overcast.

Mr. F. F. Hilder ("Kansas Review of Science and Industry") controverts the conclusions of Dr. J. F. Snyder that the "Redskins found in North America by the first European explorers were "the people, or the immediate descendants of the people, who built the mounds." Mr. Hilder shows that the mound-builders must have had considerable mathematical knowledge; that they had fixed habitations and idols, of the origin of which the recent Indians confess themselves entirely ignorant.

Dr. C. Viguier ("Comptes Rendus de la Société de Geographie de Paris") ventures to suggest that there exists in man and in

the higher animals an especial sensorial organ (where situate ?) for the perception of magnetic movements. This he considers is the faculty by which savages and animals are guided in unknown regions.

M. Dufour (Soc. Vaudoise des Sciences Naturelles) describes two remarkable hailstorms. One of these occurred on August 21st, 1881, in the Pays de Vaud, and was accompanied by a violent wind. The quantity of ice precipitated upon the Canton is estimated as at least a million cubic yards.

On July 13th, 1788, France, Belgium, and Holland were ravaged by a storm which discharged not less than 400 million cubic yards of ice. The cold produced was sufficient to cover the Lake of Geneva with ice to the depth of three-fourths of a yard. It is observed that well-wooded regions escape these visitations.

The Paris Company for the Utilisation of Solar Heat supplies portable "solar furnaces," likely to be very useful in tropical countries.

W. H. Ballon ("American Field") communicates some interesting observations on the migrations of birds of prey in America. He gives a list of nine species which are true migrants, and of twelve species which migrate irregularly. All these migrations, the author considers, are based on a food-supply.

MM. Van Tieghem and Gaston Bonnier find that of a hundred peas preserved in the free air, ninety afterwards germinated; of a hundred enclosed with air in a sealed tube, only forty-five; whilst of a similar lot shut up in carbonic acid none proved fruitful. With other seeds the numbers varied, but the proportions were substantially the same.

According to a recent death-bed confession the splendid Mastodon at Albany is a forgery! This is deplorable, as palæontological specimens generally will be viewed with suspicion.

M. de Comberousse, in a discourse pronounced at the funeral of the late Henri Giffard, made this significant admission:—"An intimate friend of Giffard told me yesterday that he carried to the tomb the secret which he had long sought for, and which had revealed itself to his eyes during his last years. He added that our colleague shrunk back from his own discovery, and, filled with horror, put an end to his existence." In other words he saw at length that aërial navigation must prove the suicide of civilisation.

A specimen of *Rafflesia Arnoldi* was in flower last month at the Berlin Botanical Gardens. The Berlinese boast that this establishment will soon surpass the Kew Gardens.

The swallows and the martins are said to have taken their departure from Paris at the end of August, instead of, as usual, about October 10th.

M. Hennessy ("Comptes Rendus") argues that the mean temperature of the Northern Hemisphere is not higher than that of the Southern.

According to Tieghem certain low plants—Ascomicetes, Mucorini, &c.—live and increase in oils in the absence of atmospheric air.

The "Deutsch-Amerikanishe Apotheker Zeitung" replies to a correspondent that "between cruelty to animals and vivisection, in the scientific sense of the term, there is a mighty difference, which many persons have not recognised and cannot recognise."

According to Prof. Xavier Landerer, of Athens, rabies is exceedingly common in the East among dogs, cats, and jackals. This observation overturns the theory that the disease is produced by confinement, chaining, muzzling, &c.

The so-called double or twin canals which have become visible on the surface of the planet Mars are occasioning much attention.

Prof. Freeman, of the Johns Hopkins University, of Baltimore, concludes, from a long series of experiments, that electricity is not demonstrably disengaged by the evaporation of fluids.

The subterranean chambers of the Observatory of Paris are about to be utilised for studying the changes which the attraction of the heavenly bodies may occasion in the reflecting surface of a bath of mercury.

Statues are about to be erected at Besançons and Beaume les Dames in honour of Claude de Jouffroy, who is now alleged to have been the originator of steam-navigation.

M. P. de Tchihatcheff, in a paper read at the recent Southampton Meeting, contends that the great deserts of Africa and Asia are not sea-beds, recently laid dry, but they have been upraised at remote geological epochs, and that their sand is not of marine origin, but is the product of rocks disaggregated by winds, changes of temperature, &c. He admits that the Asiatic deserts are much more ancient than the Sahara. At a point in the Gobi, of the same latitude as Palermo, Russian explorers found, as late as May 16th, a temperature of 22° F., and snow 2 yards in depth!

M. d'Abbadie ("Comptes Rendus") recommends fumigations of sulphur as a preservative against the effects of malaria. He gives an interesting account of the gradual ruin of Zephyria, in the island of Milo, a town once containing 40,000 inhabitants,

which became depopulated by fevers as soon as the sulphur-works were removed from its neighbourhood to the oth r side of the island.

"*The Cause of the Stratification of the Flints of the Upper Chalk.*—It has long been considered that the beds of flint in the upper chalk are the silicified casts of sponges, but opinions differ concerning the force that placed them in beds; and while modern books on geology mention enormous heat, chemical precipitation, and other old theories as the causes of their stratification, they at the same time give little credence to them. Now, it seems to me that in the habits of sponges themselves, and in the nature of the formation of the chalk in which they exist, is to be found a quite sufficient reason of their stratification. The mode of reproduction in sponges is for one of the inhabitants (embryos) to detach itself from the community and float away until it arrives at a place suitable for the formation of a colony, which it then establishes, and which, after a time, in its turn comes to maturity and sends forth its citizens with the object of fresh colonisation. Now, it is agreed on all hands that at the time living sponges existed in the chalk that substance presented precisely all the physical and chemical conditions of the Atlantic ooze, and this to such a degree that the same shells (Globigerina) that are most abundant in the one are most plentiful in the other.

"Science has shown beyond doubt that the Atlantic ooze is formed by a constant rain of these discarded shells falling from the water to the bottom.

"These facts explain the stratification of flints. We will imagine a single sponge at the bottom of the chalk sea. It thrives and sends out colonists, which have not far to go, as the land surrounding the old city is unoccupied. Consequently six new cities are ranged round the old one, and thrive and grow to prosperity. During this time the rain of chalk has been constantly falling, but the deposit has been greater on the old and central city than on the colonies, because it has existed longer. The six sponge cities then desire to colonise. They send out embryos, which obviously cannot form colonies in the direction of the old original sponge, but start in the direction of the as yet unoccupied ground, forming fresh colonies, which become cities, and in turn commence colonisation. Thus the original sponge grows into a circular patch of sponges, which after a length of time, in consequence of the falling of the chalk rain, must become a ring of life whose vitality is greater at the outer edge, and which gradually fades into death towards the inner as the central sponges become choked and covered by the shell rain, and are too far from the enegetic and external ring of life to be directly colonised therefrom.

"As any sporule starting from a healthy sponge on the outer edge of this ring would find in one direction an open field for

colonisation, and immediately behind it nothing but compact masses of life, and even if it should sail by accident far back over the healthy inhabitants, it would in all probability only come to those suffering more and more from suffocation and decomposition the farther it went (but even should it so happen at any time that it should travel so far towards the centre of the circle as to reach a place where its ancestors had been completely buried and start there a colony, it would only perform over again what the first sponge had done and what I have attempted to describe, and so form the second layer of sponges); therefore it must naturally develop in the direction of the unencumbered surface.

"Thus this ring of life would pass over the bottom of the sea, to be followed by another ring from another source, after an epoch of uninterrupted chalk deposition, or may be the same life would return after a tour in other seas.

"Thus it is possible that, in the past and the future, wave after wave of sponge life may pass over the ocean floors whose existence may be registered in stone by the separation of the small quantity of silica contained in the nacre of the Foraminifera.—A. ANTHONY NESBIT."

(In borrowing the above notice from our contemporary, "Land and Water," we wish to bespeak for it the attention of our geological readers.—ED. J. S.)

ERRATUM.—Page 553, line 22, *for* "adult" *read* "earlier."

XUM